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A COMPUTER PROGRAM FOR TRACKING COST/SCHEDULE CONTROL SYSTEMS C--ETC(U)

JUN 77 L M SMITH

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1 OF 2

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REPORT NO. PMSA-2-5

A COMPUTER PROGRAM FOR TRACKING COST/SCHEDULE CONTROL SYSTEMS CRITERIA

JUNE 1977

LOUIS M. SMITH

PROJECT MANAGER
SELECTED AMMUNITION
DOVER, NEW JERSEY

(See form 1473)

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LOUIS M. SMITH
Operations Research
Analyst

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ABSTRACT

This report describes a computer program that provides a means for tracking contractor's performance where Cost/Schedule Control Systems Criteria are utilized. The program was specifically designed for the Control Data Corporation 6500/6600 computer system at USA Armament Research and Development Command, Dover, NJ. Input data for the program are those normally found in a contractor's Cost Performance Report. Program output is a series of cost ans Schedule Performance Index graphs, a summary variance graph, and a set of table th t s mmarizes CS^2 parameters.

INTRODUCTION

The purpose of this report is to describe the computer program currently being utilized by adjuncts of the Project Manager for Selected Ammunition, Dover, NJ, to satisfy Cost/Schedule Control Systems Criteria (CS^2) requirements.

The CS^2 requirements, procedures and techniques are adequately documented[1] and these policies will not be further propounded. For purposes of clarity, however, some basic terms and acronyms are described throughout the report to assist those readers who have not totally committed to memory the CS^2 jargon.

The program is written in Fortran IV for the CDC 6500/6600 computer and uses a plotting technique, PRINTERPLOT[2], written specifically for local utility. (The author of PRINTERPLOT has expressed his willingness to provide the routine and assist in its placement into computer libraries at other installations.) The Fortran statements written to produce printer graphs with the PRINTERPLOT routines are almost identical to those statements used for CALCOMP plotting. With some further effort, the pertinent Fortran lines in this program can be converted to CALCOMP plotting or other plotting instruments.

[1]Superscripts refer to similarly numbered entries in the References.

INPUT DESCRIPTION

The CS^2 Terminology

Budgeted Cost of Work Scheduled (BCWS) - The budget cost of the effort on a work package (element), completed or in-progress, that was scheduled to be accomplished at the time of the reporting period.

Budgeted Cost of Work Performed (BCWP) - The budgeted dollar value of the accomplishments achieved on a work element at the time of the reporting period.

Actual Cost of Work Performed (ACWP) - The cost actually incurred and recorded in accomplishing the work performed on a work element at the time of the reporting period.

Other Input Terminology

Contract Target Cost - The total budget as defined by the negotiated contract cost (including the following 3 terms described below).

Management Reserve - An amount of the total budget withheld for management control purposes and not assigned to a specific work element.

Undistributed Budget - An amount of the total budget which has not been assigned to a specific work element. For the purposes of this program this item can be additionally defined: it is a part of the total budget which has been assigned to a specific work element which was not scheduled to begin at the time of the reporting period.

G and A - An amount of the total budget set aside for general and administrative purposes.

Estimated Cost at Completion (EAC) - The contractors estimated cost at completion of the contract effort including the actual direct costs and indirect costs of all work completed and authorized work remaining.

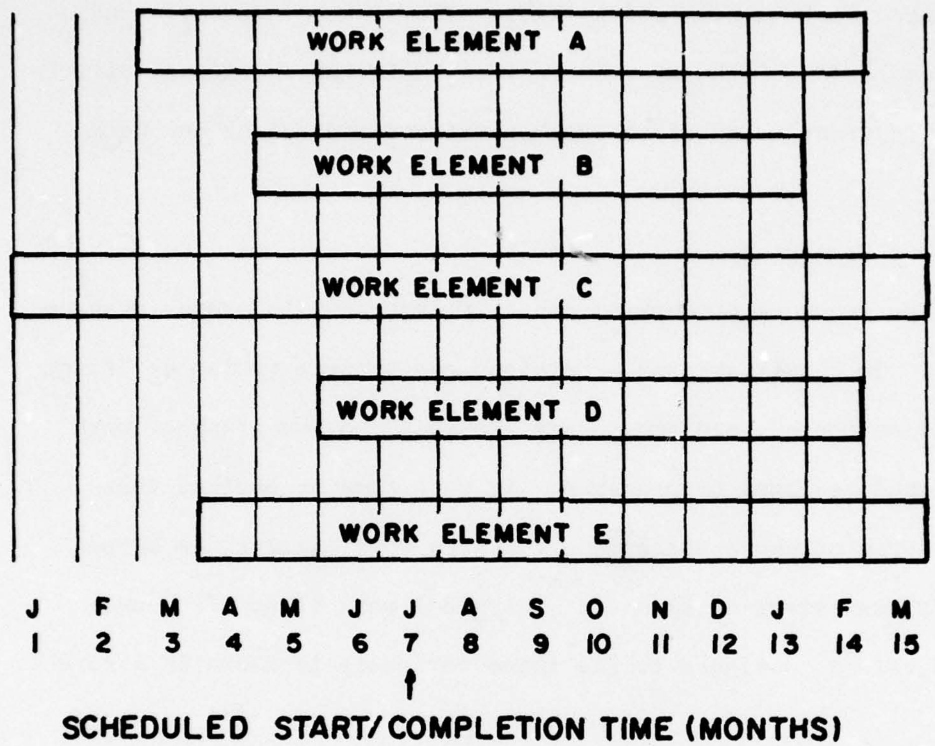
Work Element Schedules

The time sequence of work elements is important to proper program execution. To facilitate and understand the program variables "first month", "last month", and "months in progress", a bar-graph of work element schedules must be prepared. It will then be obvious that the definition of these variables, for each work element, is keyed to the earliest starting element. A typical work element/schedule chart and values assigned to the three variables is shown in Figure 1.

Casting Out Zeros

The program contains many computations, cost variance percent and schedule variance percent are two examples, that involve simple division. In the two examples cited, the available values of the current BCWP and ACWP are used as denominators. Zero values for these CS^2 terms are not uncommon, viz, work scheduled for a work element may not have been accomplished and no charges were accrued; thus BCWP = ACWP = 0. (Persons responsible for tracking CS^2 will attest that reasons for the above occurrence are legion.)

The program will not accept zeros for values of BCWP and ACWP. Therefore, to allow computations to proceed when a 0 value is reported,



WORK ELEMENT	FIRST MONTH	LAST MONTH	MONTHS IN PROGRESS (JULY)
A	3	14	5
B	5	13	3
C	1	15	7
D	6	14	2
E	4	15	4

Fig. 1 Typical Bar Chart of Program Element Schedules

the user must enter the value, 1 (dollar). The program results will not be altered in that gross cost and schedule variances will still be highlighted.

Program Limits

The program will accept data for as many as twenty (20) program elements for a duration of twenty (20) months.

Dollar values entered may be exact to the dollar up to 8 digits (99999999 max) or may be rounded-off as desired. All values must have similar units. Whole dollar and rounded-off dollar entries will result in erroneous output and may prematurely terminate the execution of the program.

Related CS^2 Input

The program allows, in summary fashion, the inclusion of CS^2 information of a related effort. Thus, if an in-house effort, with CS^2 provisions is in progress concurrent with a contract effort, the data provided in the Cost Performance Report of the in-house effort can be included for consideration in the program output. Other uses for this optional input are possible.

THE DATA DECK

Data Card Formats

Table I is a description of each of the cards in the data deck including the variable names, their purpose, their column location and the formats of the entered values.

Typical Data Deck Setup

Figure 2 illustrates the setup of a typical data deck. If the value on Card Type 1 is a 0 (zero), Card Type 1a is omitted. Any value other than zero on Card Type 1 must be accompanied by a Card Type 1a.

The illustration shows the repetitive nature of Card Types 10 through 12 for a job with two program elements, each element schedule being three months in length.

Data Deck for a Sample Case

Table II is typical of input for this program, each line representing one data card type as described by Table I. This ficticious input data is used as a sample case to provide reference material, Appendix A, for the discussion of program output.

TABLE I - DATA CARD FORMATS

CARD TYPE	VARIABLE NAME	COLUMN	FORMAT	DESCRIPTION
1	KEY3	1	I1	KEY3 = 1; allows program reading of related effort data, card 1a. KEY3 = 0; no related effort exists.
1a	DBCWS	1-10	F10.0	For related effort: the budgeted cost of work scheduled.
	CBCWP	11-20	F10.0	The budgeted cost of work performed.
	CACWP	21-30	F10.0	The actual cost of work performed.
	CCV	31-40	F10.0	The cost variance.
	CSC	41-50	F10.0	The schedule variance.
	CGTB	51-60	F10.0	The total budget.
	CEST	61-70	F10.0	The estimated cost at completion.
2	OCTC	1-10	F10.0	The total budget as defined by the negotiated contract cost.
3	KEY1	1-5	I5	KEY1 = 0 prevents printing of cost and schedule variance graphs. KEY1 = 1; allows graphic output.
	KEY2	6-10	I5	KEY2 = 0; prevents printing of CS^2 elements graph. KEY2 = 1; allows graphic output.
4	DA1 DA2	1-10 11-20	A10 A10	Alphanumeric date of report. Max = 20 characters.
	WKS	21-25	F5.0	The number of weeks in the current + 2 previous reporting periods.
5	NK	1-3	I3	Number of work elements as of the current report period.
6	HTN	1-10	A10	Alphanumeric month of the earliest starting work element.
	IYR	11-14	I5	Year of earliest starting work element.

TABLE I (continued)

CARD TYPE	VARIABLE NAME	COLUMN	FORMAT	DESCRIPTION
7	NAME(1,NK+1) NAME(2,NK+1) NAME(3,NK+1) NAME(4,NK+1) NAME(5,NK+1)	1-10 11-20 21-30 31-40 41-50	A10 A10 A10 A10 A10	Alphanumeric title of the program including contractor name, item name and nomenclature, and contract number. In any order, max = 50 characters.
8	UB	1-10	F10.0	The undistributed budget.
	GA	11-20	F10.0	The original contract G&A amount.
	GA1	21-30	F10.0	The current contract G&A amount. This value may be identical to the original G&A.
9	MRO	1-10	I10	The original contract Management Reserve.
	MRP	11-20	I10	The Management Reserve that was current in the previous reporting period.
	MRC	21-30	I10	The current Management Reserve.

Card Types 10 through 12 are grouped for each of the NK work elements.

CARD TYPE	VARIABLE NAME	COLUMN	FORMAT	DESCRIPTION
10	NAME(1,i) NAME(2,i)	1-10 11-20	A10 A10	Alphanumeric title of the ith program element. Max - 20 characters.
11	M(i)	1-5	I5	Months in progress for the ith work element.
	IFM(i)	6-10	I5	The numerical value of the first month of the ith work element. See test "Input Description - Work Element Schedules)."
	LM(i)	11-15	I5	The numerical value of the last month of the ith work element. See text noted above.
	TB(i)	16-25	F10.0	The total budget for the ith work element.

Card Type 12 is repeated for each month of the existence of the ith work element. The number of cards will be LM(i) - IFM(i) + 1.

CARD TYPE	VARIABLE NAME	COLUMN	FORMAT	DESCRIPTION
12	BCWS(i,j)	1-8	F8.0	The budgeted cost of work scheduled for the ith work element on the jth month. For future months, (beyond the current report period), only the BCWS(i,j) will appear on this card.
	BCWP(i,j)	9-16	F8.0	The budgeted cost of work performed for the ith work element in the current month. For months ahead of the current period, this entry will be blank.
	ACWP(i,j)	17-24	F8.0	The actual cost of work performed for the ith work element in the current month. For months ahead of the current period, this entry will be blank.
	CEAC(i,j)	25-32	F8.0	The contractor estimate at completion for the ith work element in the current month. For months ahead of the current period, this entry will be blank.

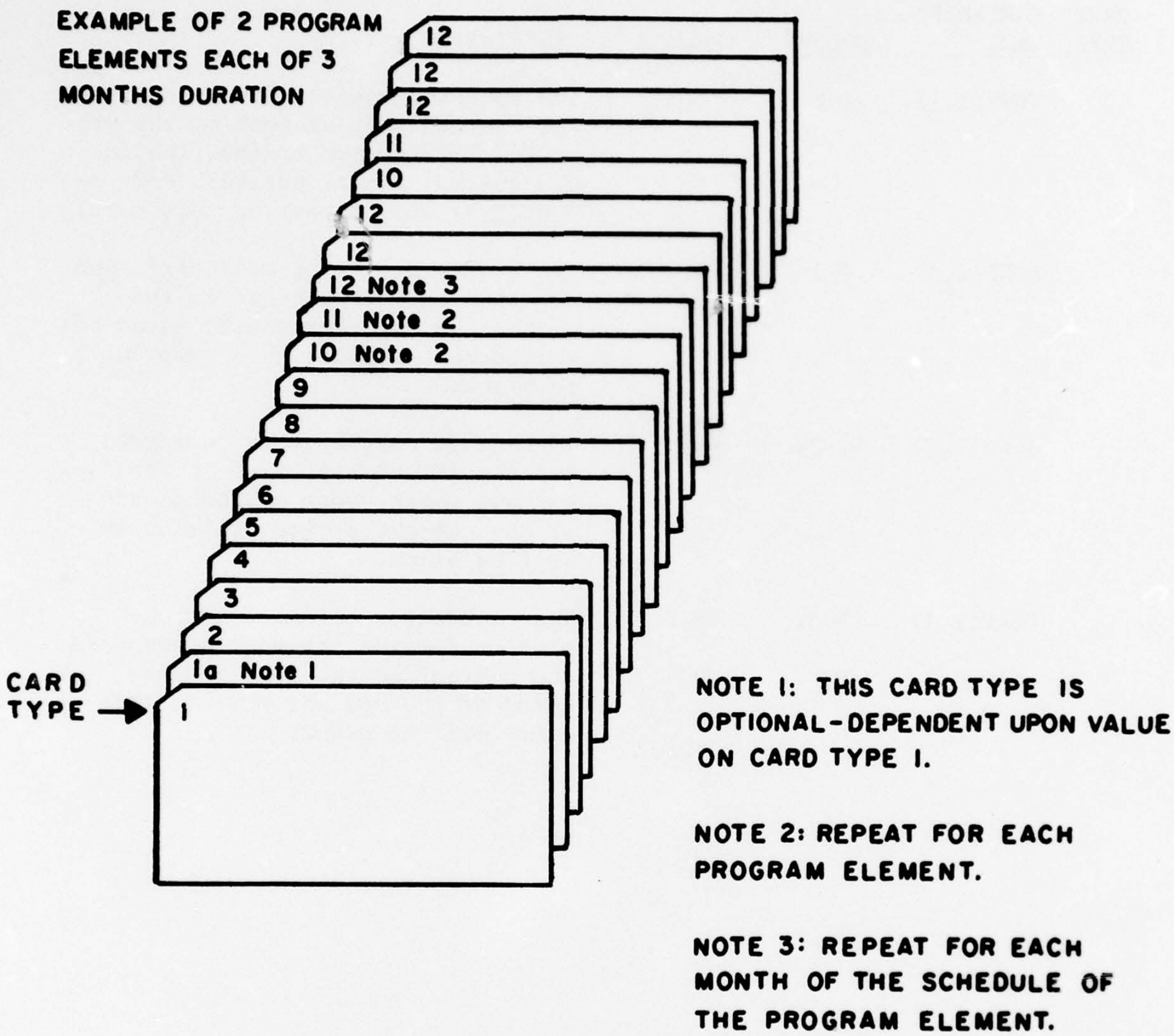


Fig. 2 Typical Data Deck Setup

TABLE II - TYPICAL INPUT FOR SAMPLE CASE

```
0
   1281591
    1    1
31 SEP 1977                13
  8
APRIL      1976
WHOSOMEEVER ED CONTRACT 76-C-0214 CART, XM185E1
          0      888003    1076420
    310347     310347     310347
SYSTEM INTEGRATION
    6    1    10      116113
     6278      8629      8629     80469
    20415     20200     20200     78587
    34252     30000     29995     79995
    50273     49208     49200     79408
    63510     61000     60580     73330
    71713     63400     73400    117764
    81313
    92913
   104513
   116113
CARRIER METAL PARTS
    6    1    10       95413
     6664      6562      6560     76307
    16733     19200     19200     80074
    32132     37300     37262     85962
    52424     53500     53538     78338
    67323     70500     70537     83937
    81413     81200     81200     95181
    86613
    91213
    94813
    95413
GRENADE METAL PARTS
    6    1     9      197377
     8712      7800      7805     69570
    25151     27400     27400     79385
    49540     34400     34353     67753
    59582     66400     86708     99408
    66171     80000    101473    106323
   114377    102200    124200    197216
   182177
   195577
   197377
FUZE ASSEMBLY
    6    1     9      151106
    17612     13918     13900     74613
    30061     33400     33400     83131
    46790     58000     57944     83644
    68182     71500     71470    100770
    76011     82000     84721     95221
```

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TABLE II - TYPICAL INPUT FOR SAMPLE CASE (cont)

```
  102106    98600    98600   151649
  120306
  138506
  151106
GRENADE LDG+ASSBLY
     6     1    10      37933
     700      800      800    20039
    4088     2400     2400    19709
    8979     4700     4765    23865
   13808     8800     8802    21902
   14509    12300    12253    19753
   15353    15000    25000    37923
   17473
   24693
   31913
   37933
PROJECTILE ASSEMBLY
     6     1    10      21559
     600      620      620    12018
    2418     1400     1400    11794
    4739     2600     2628    13428
    7708     5200     5249    12149
    9500     8200     8170    10970
   10279    12100    12635    21509
   11179
   14319
   17459
   21559
SELF DESTRUCT
     6     1    10     283500
   32830    32420    32420   250845
  197702    42700    42700   250324
  217574   184700   184717   249217
  229914   197600   197615   257615
  239786   228000   235403   248403
  245700   246000   246000   283834
  257100
  268500
  279900
  283500
TOOLING
     6     1     9      54232
    6080     7100     7120    52178
   16890     9400     9400    50269
   29685    16000    16020    51135
   39405    32300    32298    49298
   41770    40300    40127    45627
   44872    49900    49900    54175
   49992
   52112
   54232
```

OUTPUT DESCRIPTION

The output of the program consists of 4 optional graphs for each program element and the total program (all the elements summarized), a variance graph for the total program, and a set of tables that presents various facets and types of CS^2 information. Each of the separate kinds of output is discussed below.

The Schedule and Cost Performance Index Graphs

The schedule and cost performance graphs for each element and the total program are plotted in the format of Favorable/Unfavorable (performance) vs Months in Progress. When the variable KEY1 = 0, these graphs will be omitted. For each program element, the zero baseline of the index is its scheduled performance. Favorable or unfavorable performance indices range from 0 to + 1.0 and 0 to - 1.0, respectively. The indices are computed and the graph routines are defined in SUBROUTINE INDEX. The Schedule Performance Index is the difference between BCWP and BCWS as a fraction of BCWP, or:

Schedule Performance Index = (BCWP - BCWS) ÷ BCWP

The Cost Performance Index is the difference between BCWP and ACWP as a fraction of BCWP, or:

Cost Performance Index = (BCWP - ACWP) ÷ BCWP

Note that the indices will be + 1.0 (most favorable) when BCWS or ACWP is zero or when the BCWP is twice the value of BCWS or ACWP; both of these occurrences are improbable. Poor performance indices occur when the BCWP falls below the level of BCWS or the ACWP climbs above the BCWP.

This program gives special treatment to computation of performance indices (and Estimates of Cost at Completion) for the 1st three months of effort on program elements greater than 6 months duration. The purpose for this treatment is in recognition of the fact that as a result of start-up efforts larger unfavorable performances may be encountered regardless of a contractors demonstrated proficiency. To compute performance indices and Estimates of Cost at Completion based on such early subnormal performance, when it occurs, would raise flags prematurely. To preclude this, the program redefines the contractor's BCWP by the following formulas:

1st Month: BCWP = .3 BCWS + .7 BCWP (as reported)

2nd Month: BCWP = .1 BCWS + .9 BCWP (as reported)

3rd Month: BCWP = .05 BCWS + .95 BCWP (as reported)

In the event that the contractor's cost or schedule variance is unfavorable, as indicated by his reported BCWP, the above formulas will reduce his apparent deficit. Note that as the effort on an element approaches 3 months, the reduction of the contractor's deficit tends to disappear. In the 4th month, finally, he is burdened with the full impact of his unfavorable variance.

When that contractor reports no variances, the formulas will not alter the reported BCWP.

In the same manner that the program gives the contractor a 'break' when reporting early subpar performances, it tends to 'disbelieve' early efficiencies when the contractor reports ahead of schedule or

underrun cost performance, i.e., BCWP > BCWS or BCWP > ACWP. But the formulas will also reduce to zero, on the 4th month, the extent of disbelief. The effects of the formulas on the reported BCWP both favorable and unfavorable, are shown schematically in Figure 3.

It should again be stressed that the reformulation of the contractor's reported BCWP does not occur in program elements that are shorter than 7 months in duration. In such a program element the contractor is given no leeway in regard to his performance.

Finally, reformulated BCWP values are used only for computation of performance indices and Estimates of Cost at Completion. The reported BCWP is shown in all tables, which will be discussed later in this report.

Cost Performance Index 3-Month Moving Average Graph

When the contract effort reaches 3 months, this graph shows the trend of the Cost Performance Index, of individual program elements and the total program, by averaging the values of the index over the previous three months. The 3-month moving average of the Cost Performance Index is a statistic that is not usually discussed in CS^2 circles and this graph is provided for the casual interest of the users. In certain instances it may provide a special insight to the progress of the program. This graph is also omitted when variable KEY1 = 0.

The Summary Graph

The fourth graph provided in the output, again for each program element and the total program, plots the cumulative BCWS, BCWP and

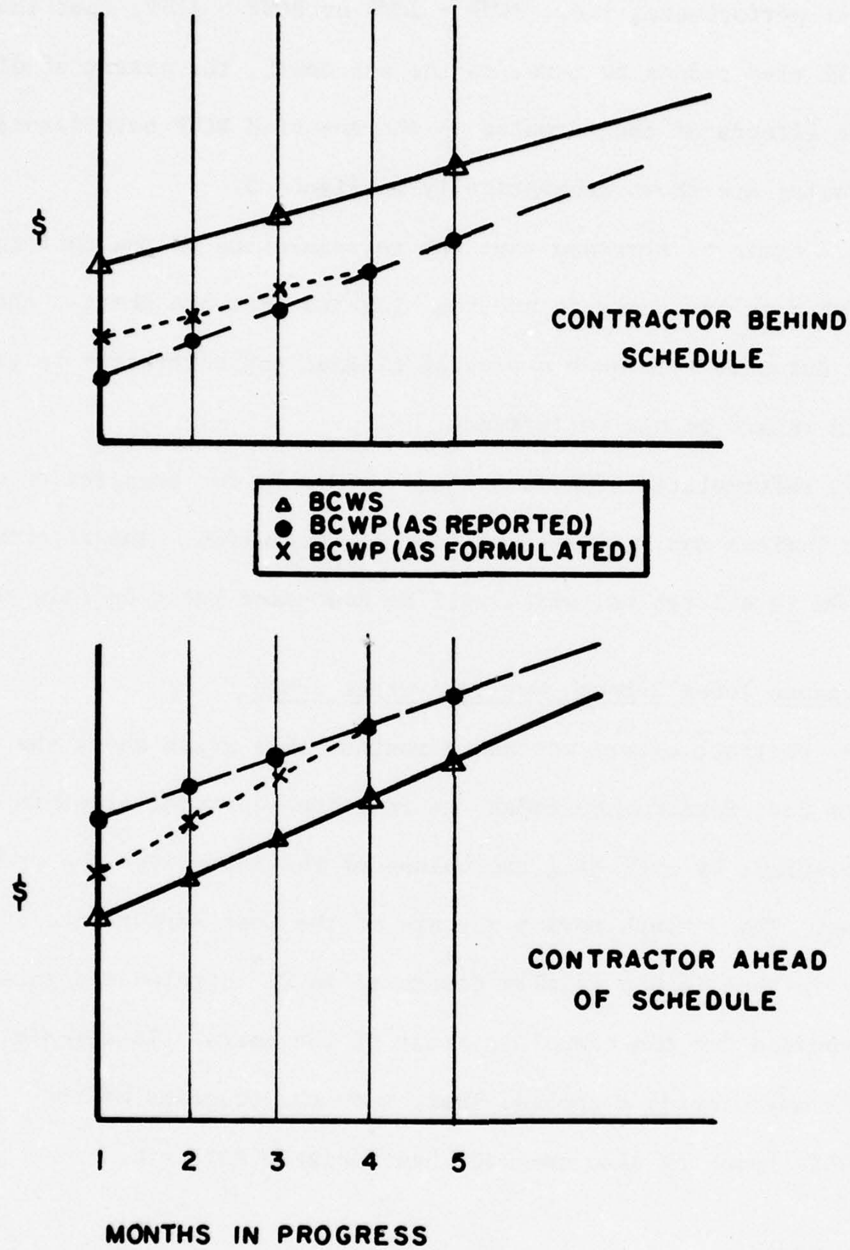


Fig. 3 Schematic Drawing Showing Relationship Between Reported and Formulated BCWP

ACWP dollar values against time in months that the effort has progressed. The complete schedule, cumulative BCWS, is shown from first month to last month. In the event that BCWP and ACWP are very close in value, the graph prints the code letter A (ACWP) preferentially and suppresses the printing of code letter P (BCWP). This graph is structured and printed by SUBROUTINE GRAPH and may be omitted by setting variable KEY2 = 0.

The Variance Analysis Graph

One of the key graphs in the output of this program is the variance analysis graph. No option is provided for eliminating this graph which is structured and printed from SUBROUTINE TREND. The format of the graph is Favorable/Unfavorable (performance in dollars) vs calendar Month/Year and it tracks the progress of the dollar schedule and cost variances of the total program (all elements summarized). The base line of performance (zero dollars) is the sum of all the program element BCWP's and the cost and schedule variances are measured and plotted against this base line.

This graph presents an excellent overview of the progress of the contractor's effort on the overall program. While this CS^2 computer program was conceived and generated prior to the existence of the US Army Materiel Development and Readiness Command (DARCOM), this graph very nearly fulfills the DARCOM Review and Command Assessment of Projects (RECAP)[3] requirement for the "Contractor Cost/Schedule Variance Trends......" chart, a sample of which is shown on page A-36 of the

referenced publication. The various parameters shown in the Variance Analysis graph are discussed below.

Cost Variance - The difference, in dollars, between the BCWP and ACWP, or:

Cost Variance = BCWP - ACWP.

The cost variance is also expressed in % by:

Cost Variance (%) = Cost Variance (dollars) ÷ BCWP

Schedule Variance - The difference in dollars between BCWP and BCWS, or:

Schedule Variance ($) = BCWP - BCWS.

Schedule Variance is also expressed in % by:

Schedule Variance (%) = Schedule Variance ($) ÷ BCWS.

Schedule Variance in Weeks - This parameter is a conversion of the schedule variance in dollars into time. The time factor is based on the BCWP experience of the contractor over approxiamtely 4 months. It is computed from the following:

Schedule Variance(weeks) = Schedule Variance(dollars) ÷ BCWP(avg)

Where: BCWP(avg) = Cumulative current BCWP - Cumulative BCWP 3 months previous to the current month ÷ number of weeks in the current and 2 previous reporting periods.

Other Parameters - In addition to printing the progression of dollar schedule and cost variances in symbolic form (S or C), the graph

displays the cumulative schedule and cost dollar variances and percent variances through the current month. Negative values reflect unfavorable variances. Finally, for informational purposes solely, original and current contract costs and government and contractor Estimates of Cost at Completion - taken from other sections of the computer program, are printed above the variance graph. The current contract cost shown on the variance graph may differ from the original contract cost as a result of changes occurring during the life of the contract (changes of scope, etc.). Input data will reflect these changes in the form of higher element budgets or new program elements. The computer program will track these changes and display the new total on the variance graph.

The user does not have control of the limits of the axes of the variance graph. The Y axis (dollars) extremes are fixed by the level of the schedule or cost variance. The X axis (calendar months/years) minima is 1 month prior to the start of the contract effort (from input data) and extends for a 15 month period.

Cumulative CS^2 Data Table

Table 1 of the output provides a summary of the CS^2 data for the current reporting period and the computed cost and schedule variances. Each program element and the summary of all the elements is treated. The variances shown for the over-all program "All Elements" are those printed on the variance graph. Negative values designate unfavorable

situations. Information regarding management reserve funds is shown at the bottom of the tabulation.

Flagged Variances Table

In order to highlight significant results, both favorable and unfavorable, the computer program selectively prints, in Table 2 of the output, any cost or schedule variance percent that is greater than +10% or less than -10%. Similar guidelines are applied to contractor and Government Estimates of Cost at Completion where the program element budget is used as the baseline. The source of the government estimate at completion will be discussed separately in connection with Table 3 output.

With the Office of PM Selected Ammunition special attention is given to the output in Table 2. Persons responsible for tracking CS^2 information on contracts under the purview of PMSA must specifically address the causes for variances or estimates of cost falling outside of the ± 10% guidelines. This procedure allows the Project Manager to be fully and continuously aware of potential cost problems. Favorable results, while desirable, also require explanation. Contrary to the popular maxim, the proverbial "gift horse" must be fully examined.

The 10% guideline may be altered as desired. The controlling statement appears in SUBROUTINE TABLES starting 2 lines below Statement Label 2. See Appendix B.

Cost at Completion Estimates Table

The output in Table 3 consists of Estimates of Cost at Completion computed by various methods.

Estimates based on:

Cost Variance	= Element Budget ÷ Cost Variance %
Schedule Variance	= Element Budget ÷ Schedule Variance %
Cost and Schedule Variance	= Element Budget ÷ Multiple of Cost and Schedule Variance %
Trend of Cost Variance	= Element Budget ÷ Average Cost Variance % of 3 previous report periods
Average of Variance	= Summ of above variances ÷ 4

Contractor Estimate of Cost at Completion is input data.

DARCOM CS^2 procedures dictate the need for developing a government estimate at completion. The requirement is correctly based on the idea that a contractor's estimate at completion should be at all times open to question. Many techniques are available for forming an independent estimate. An excellent overview of these techniques is provided by a DSMS Research Report[4]. Most are statistical and/or historical in nature and complex techniques are also available. The procedure to obtain this number in many instances remains at the discretion of the government's CS^2'er.

The cost and schedule variance estimates discussed at the beginning of this section are standard techniques that are historical in nature; the contractor's past performance rigidly defines his future performance.

The cost and schedule variance estimate and trend of cost variance estimate are subject to the same qualification. This program provides all the variance-based estimates, including their average, and a potential user may prefer one or the other. The Office of the Project Manager for Selected Ammunition, for whom this computer program was written, uses the Bayesian technique for formulating its Government Estimate Cost at Completion.

Bayesian Forecasting

The Bayesian Approach[5] for forecasting the estimate at completion can be described most succinctly as a method to improve predictions using objective managerial judgement in conjunction with historical performance. It accomplishes this by calculating an ensuing probability from an assumed prior probability and applying this calculation to current data to derive its forecast of completion cost. However, no Bayesian estimate is derived for any program element that is less than 3 months old. This occurs because the Bayesian estimate requires values of the standard deviation of the dispersion of the ACWP and the contractor's Estimate at Completion and no values are formulated until adequate data is available. (The Bayesian technique also allows for an estimate of these values for earlier forecasts - but this option has not been written into the computer program.)

The mathematics of the technique are adequately described in the referenced report. The Bayesian technique equations are relatively

simple to manipulate; it uses only the CS^2 input data which has been dealt with throughout this report; and over several years of use by this office its forecast has proven to be most reasonable.

REFERENCES

1. a. DOD Instruction 7000.2, Performance Measurement for Selected Acquisitions

   b. DARCOM-P 715-10, AFSCP/AFLCP 174-6, NAVMAT P5243, DSAH 8315.1, DCAAP 7641.46, (C/SCSC Joint Surveillance Guide)

   c. DARCOM-P 715-15, AFSCP/AFLCP 173-5, NAVMAT P5240, DSAH 8315.2, (C/SCSC Joint Implementation Guide)

2. "Instructions for Using Printer Equivalent Calcomp Plotting Subroutines:, Thomas J. Jankunis, Concepts and Effectiveness Information Report IP-8, May 1972, ADED, Picatinny Arsenal, Dover, NJ

3. DARCOM-R 1-34, Program Reviews, Review and Command Assessment of Projects (RECAP), DA Program Report, 25 Feb 76, HQ DARCOM, Alexandria, VA

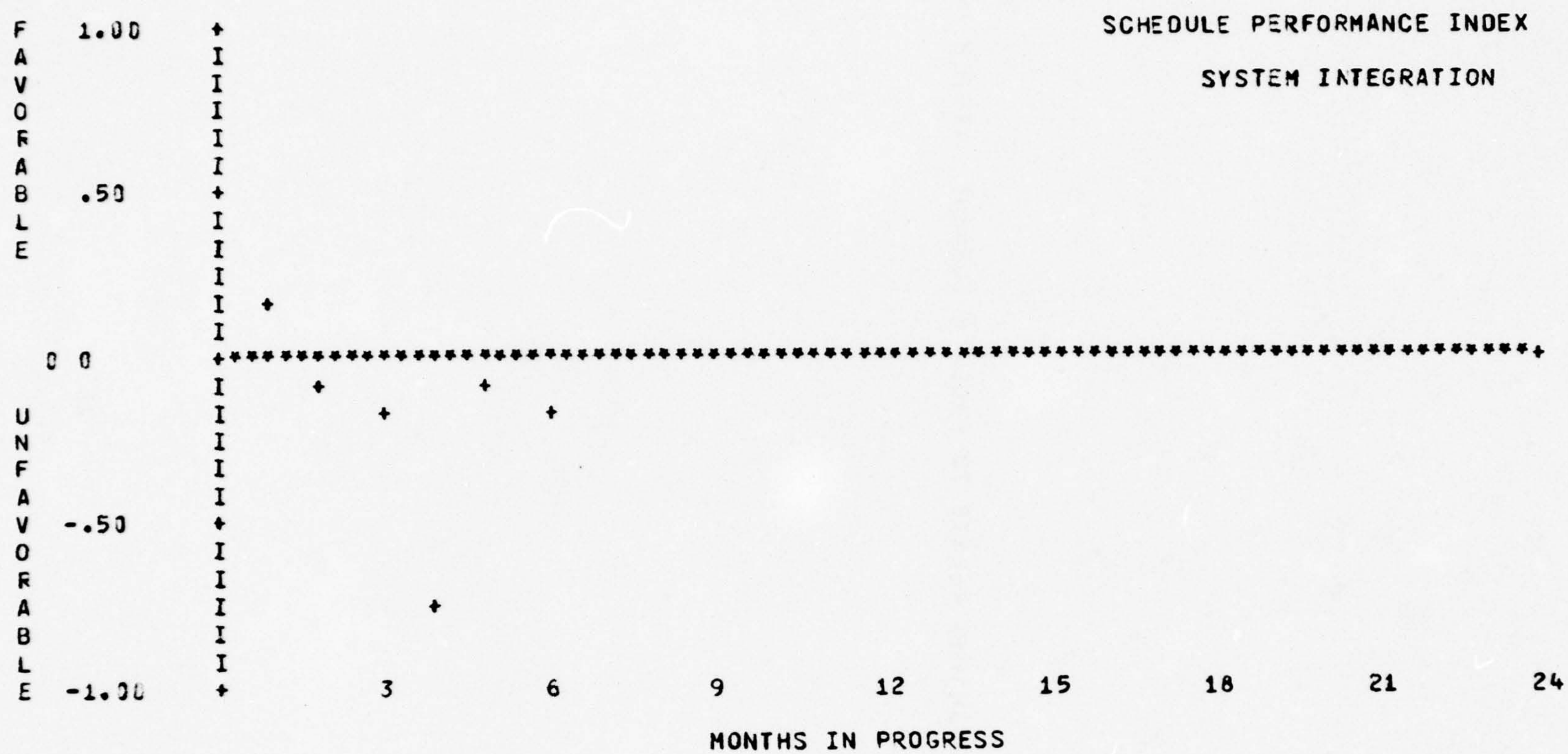
4. "A Product Improved Method for Developing a Program Management Office Estimated Cost at Completion", J. B. Holeman, Jr., Major, US Army Defense Systems Management School Research Report, January 1975.

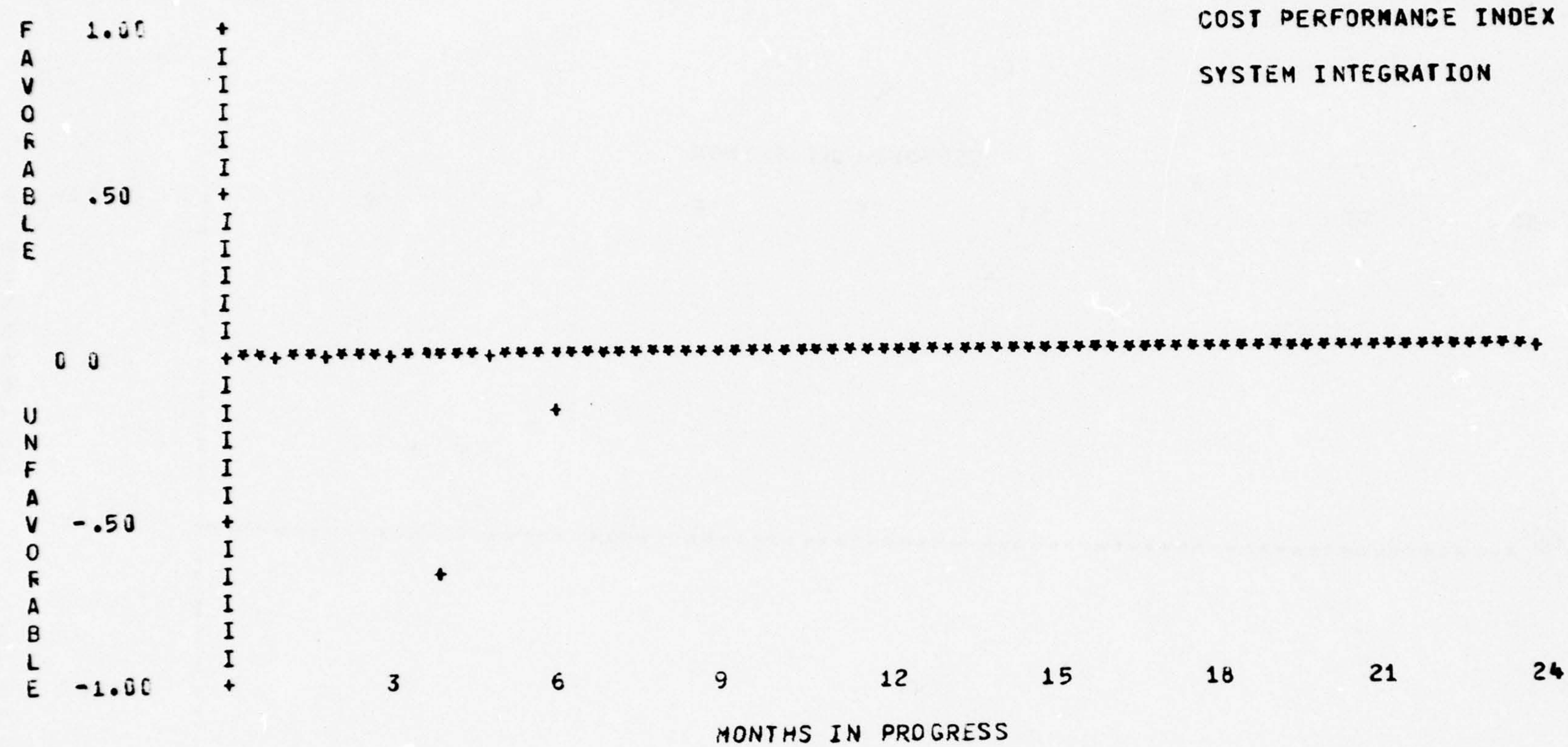
5. "Forecast of Schedule/Cost Status Utilizing Cost Performance Reports of the Cost/Schedule Control Systems Criteria - A Bayesian Approach", Mr. Zaki El-Sabban, USAAVSCOM Technical Report 73-1, Jan 1973, St. Louis, MO. US Dept of Commerce Nat. Tech Infor Service Report No. AD-754 516

APPENDIX A

SAMPLE CASE OUTPUT

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT SYSTEM INTEGRATION


SCHEDULE PERFORMANCE INDEX
SYSTEM INTEGRATION
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
SYSTEM INTEGRATION
FAVORABLE
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-1.00
UNFAVORABLE
3
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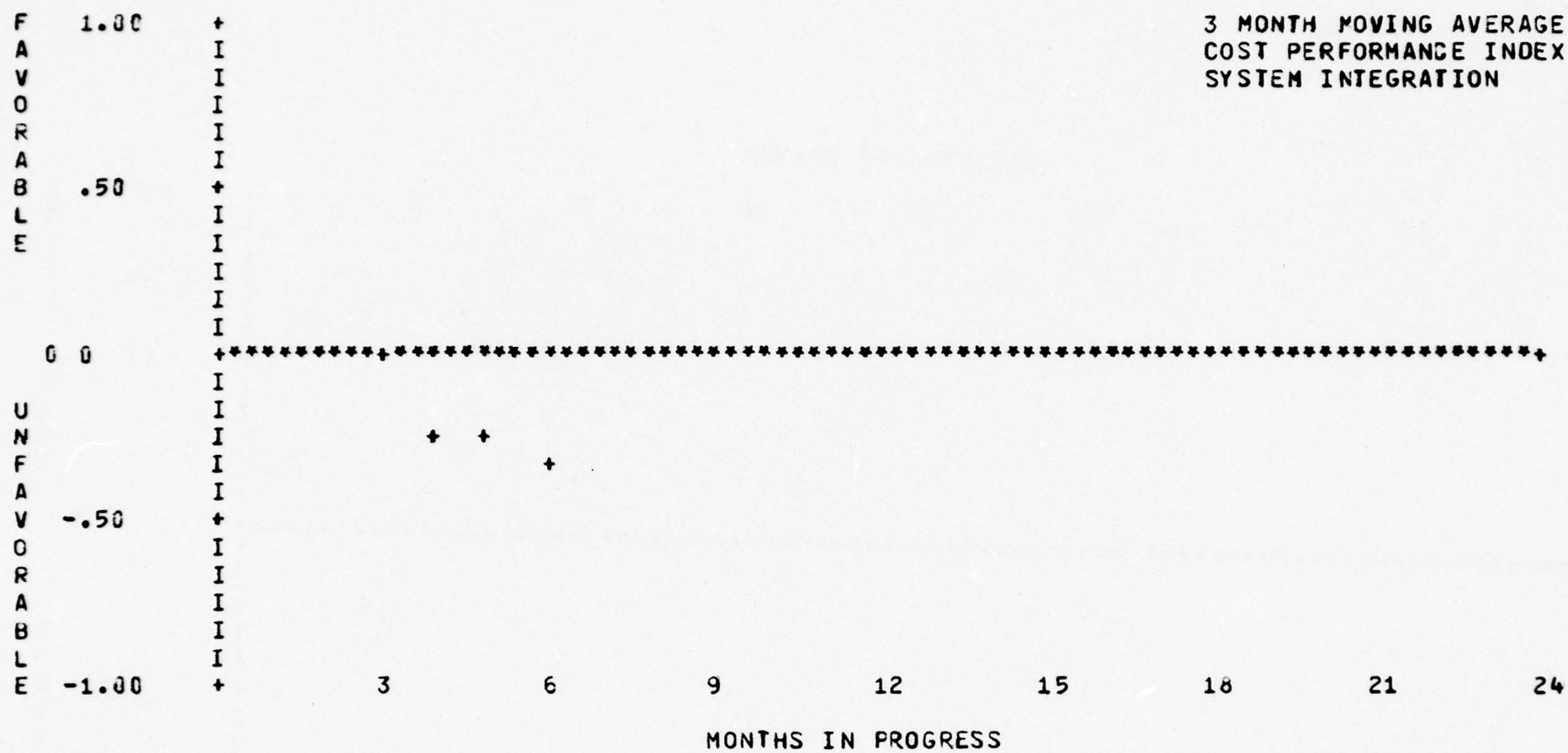
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
SYSTEM INTEGRATION
FAVORABLE
UNFAVORABLE
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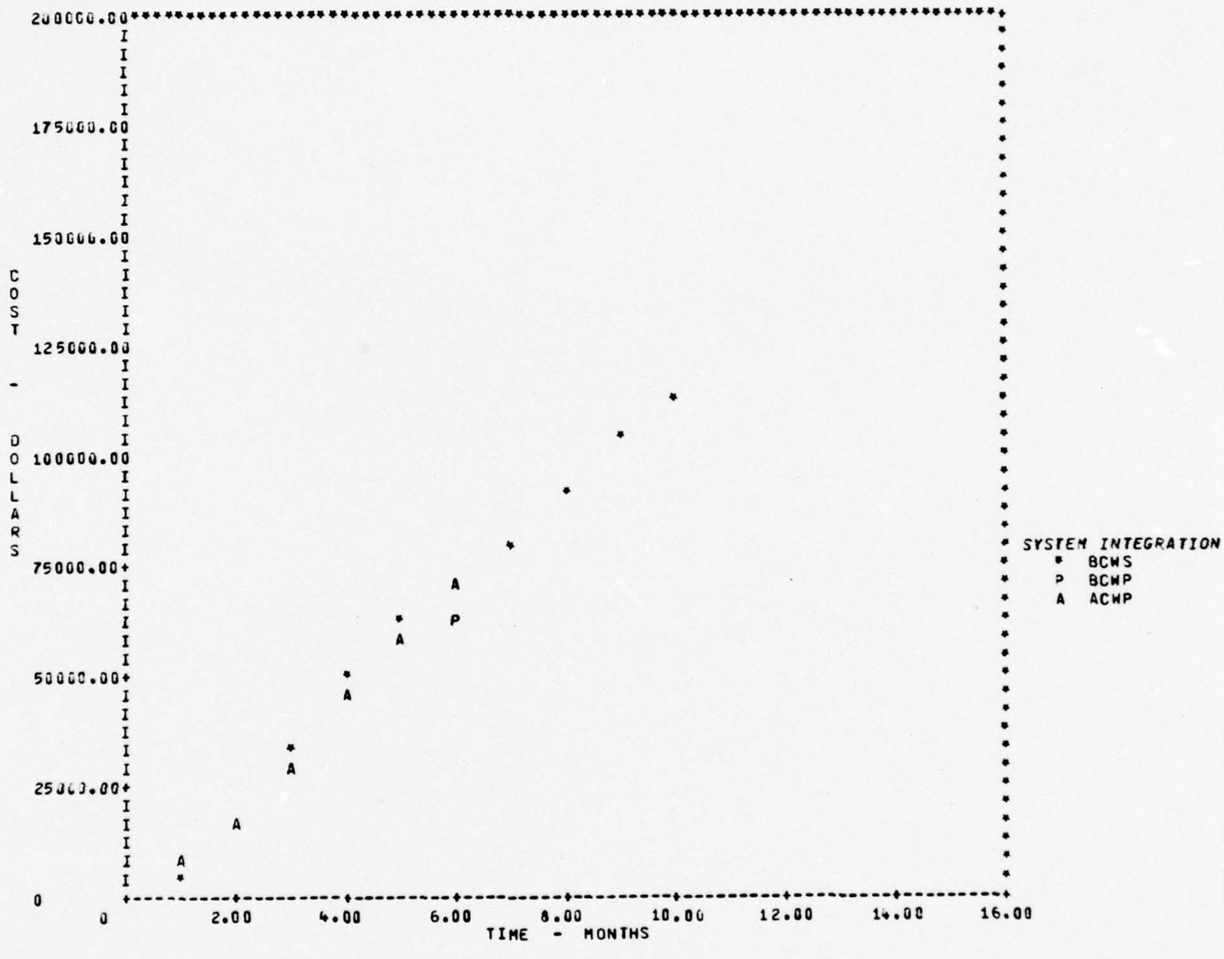
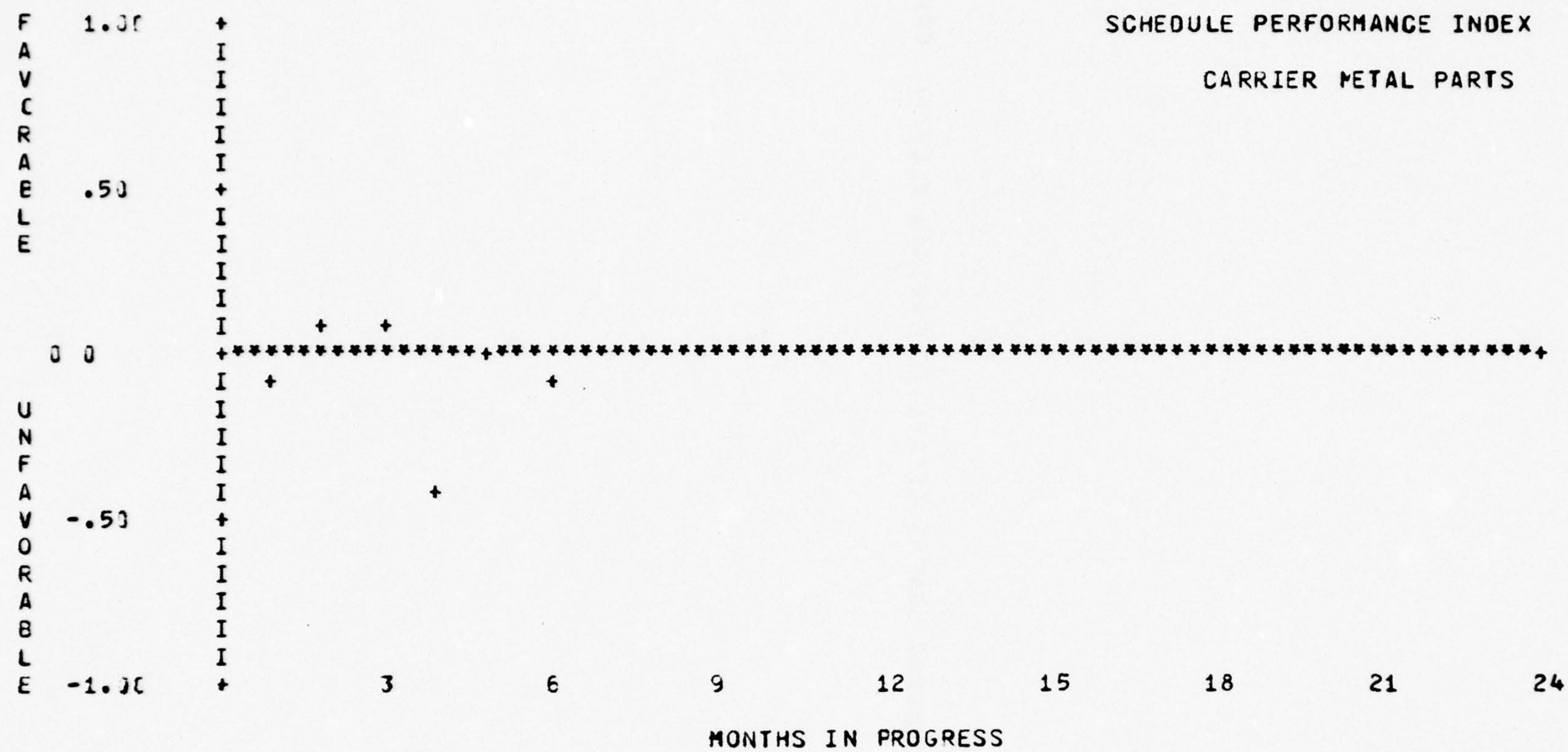
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS



200000.00
175000.00
150000.00
125000.00
100000.00
75000.00
50000.00
25000.00
0
COST - DOLLARS
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
SYSTEM INTEGRATION
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT CARRIER METAL PARTS


SCHEDULE PERFORMANCE INDEX
CARRIER METAL PARTS
FAVORABLE
UNFAVORABLE
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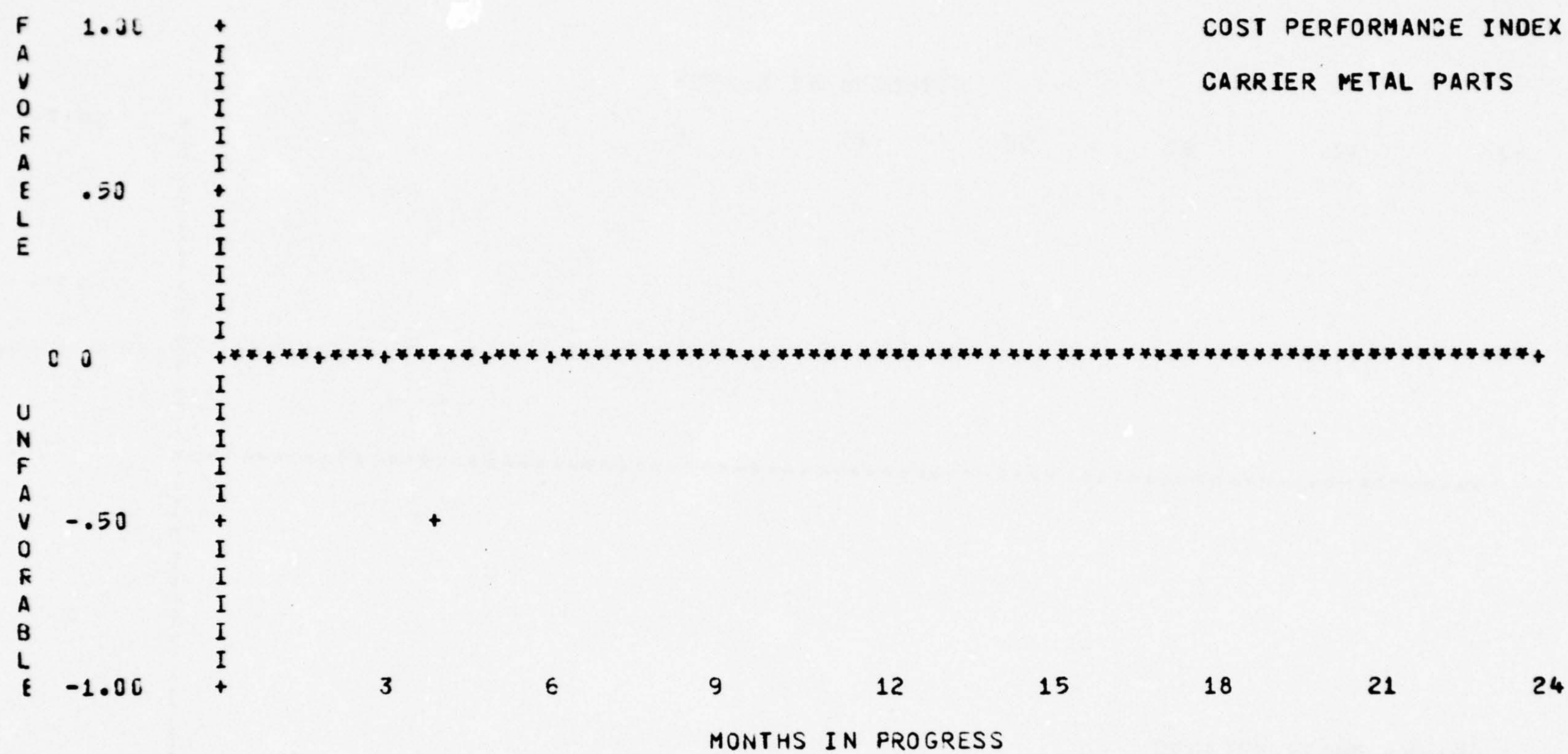
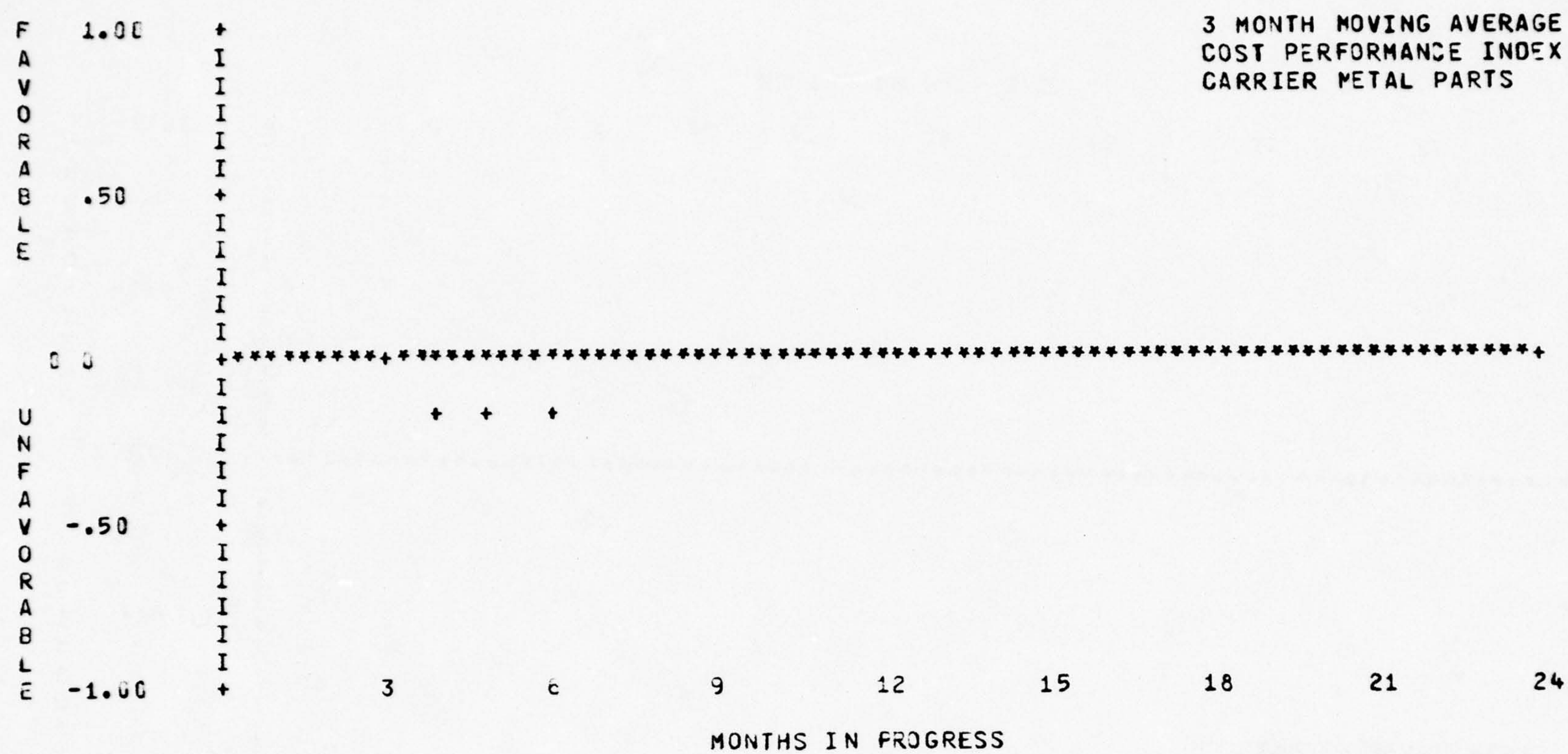
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
CARRIER METAL PARTS
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
CARRIER METAL PARTS
FAVORABLE
UNFAVORABLE
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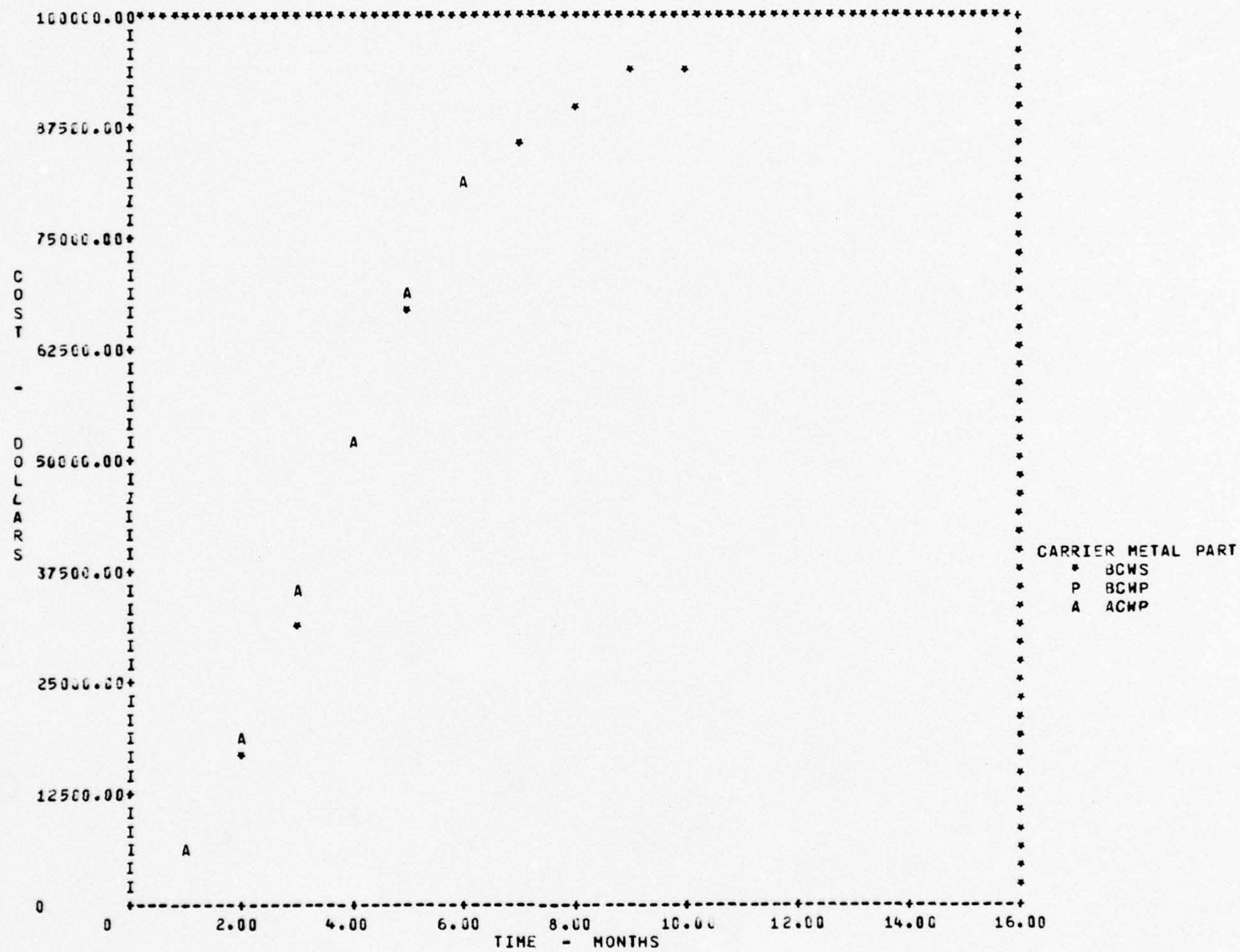
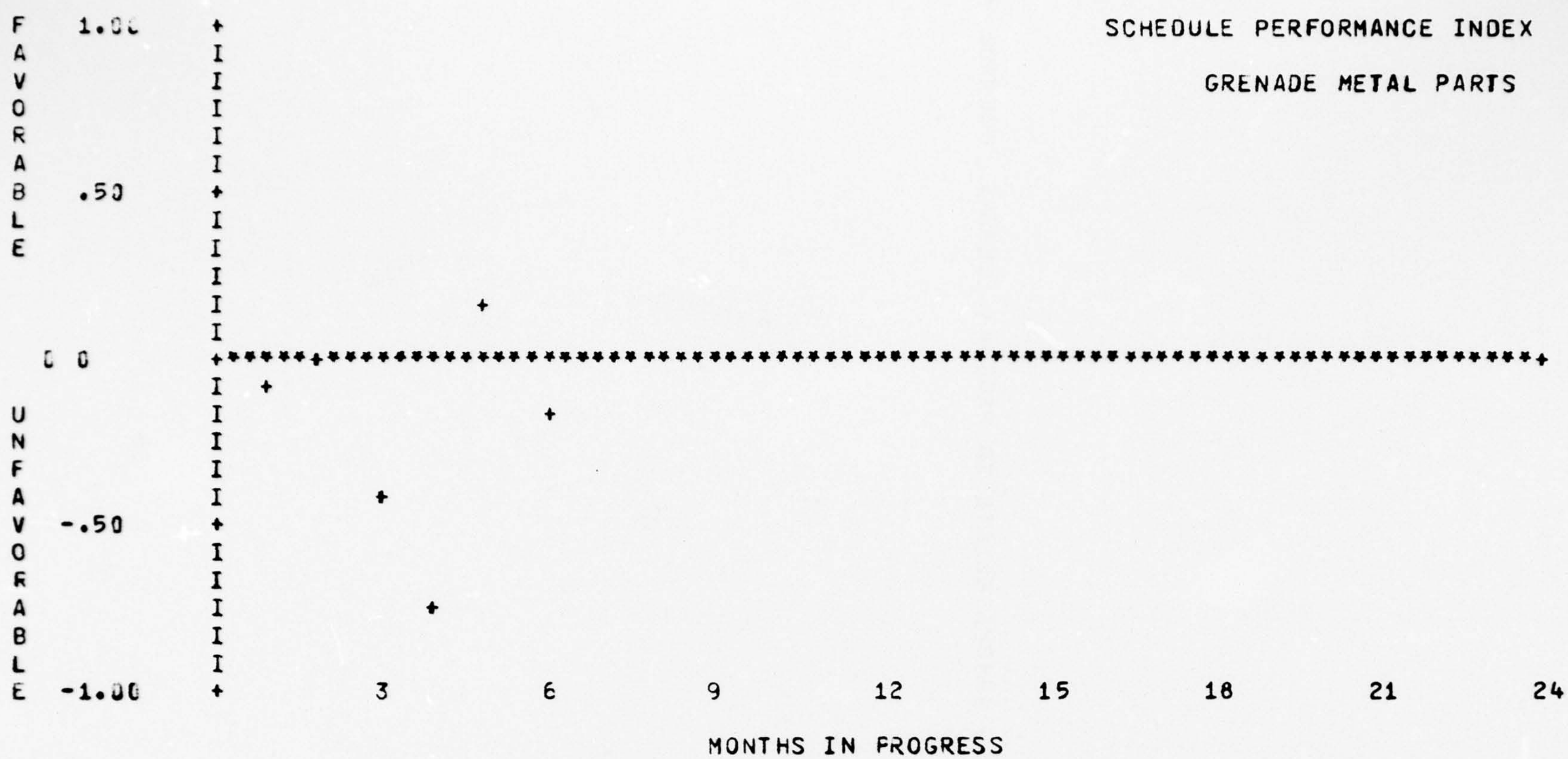
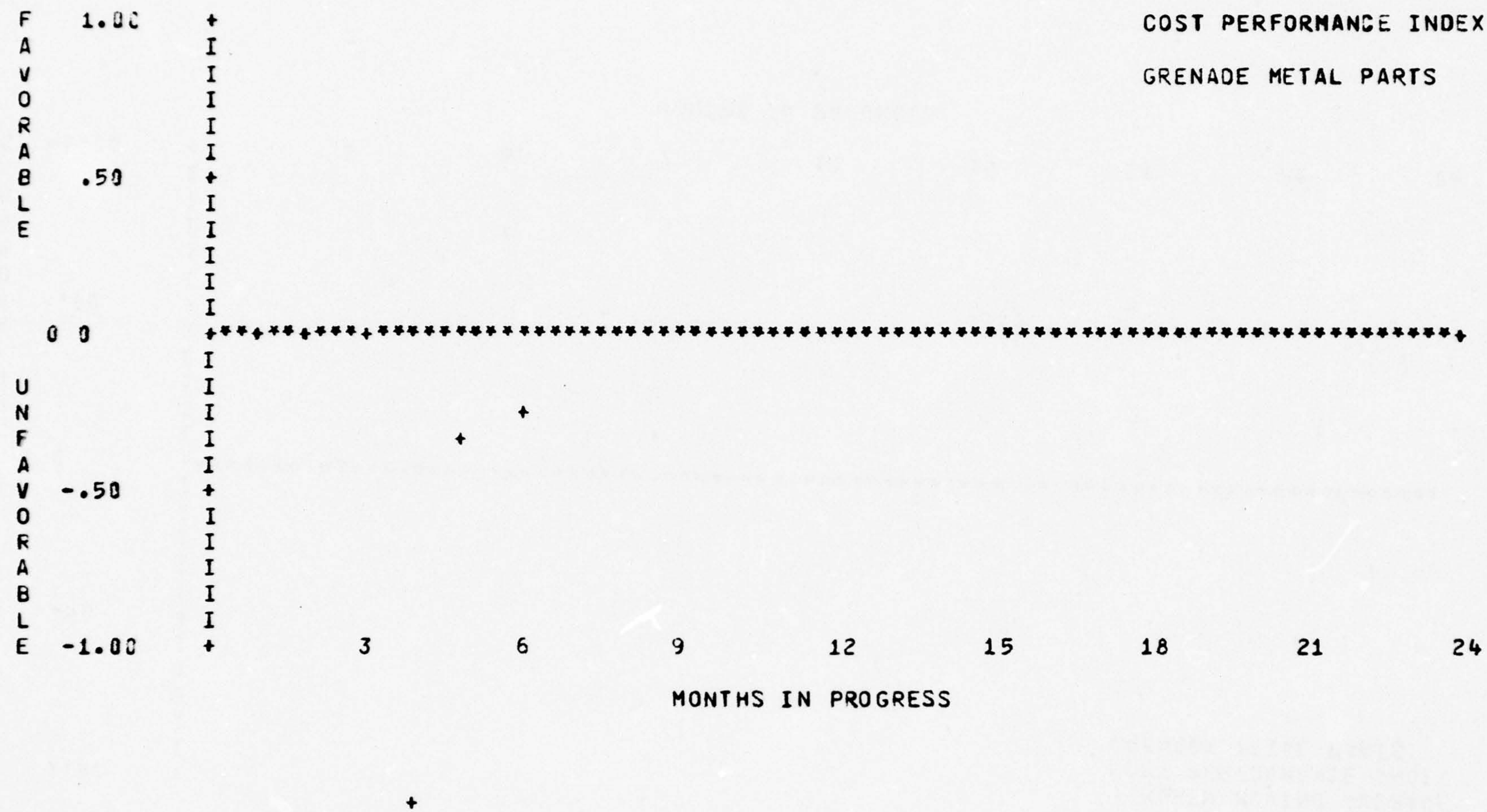
0.0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


100000.00
87500.00
75000.00
62500.00
50000.00
37500.00
25000.00
12500.00
0
COST - DOLLARS
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
CARRIER METAL PART
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT GRENADE METAL PARTS


SCHEDULE PERFORMANCE INDEX
GRENADE METAL PARTS
FAVORABLE
UNFAVORABLE
1.00
.50
0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
GRENADE METAL PARTS
FAVORABLE
UNFAVORABLE
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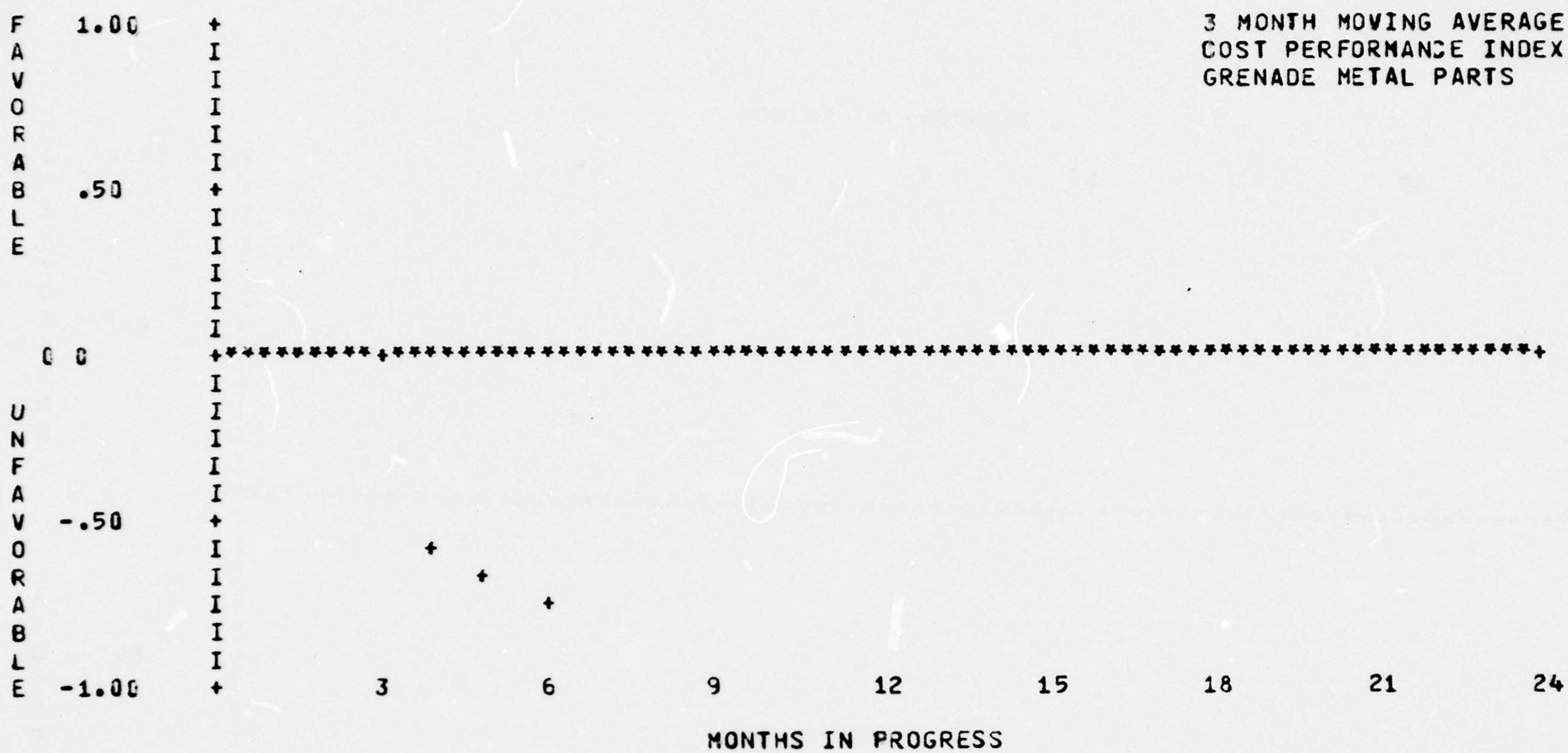
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
GRENADE METAL PARTS
FAVORABLE
UNFAVORABLE
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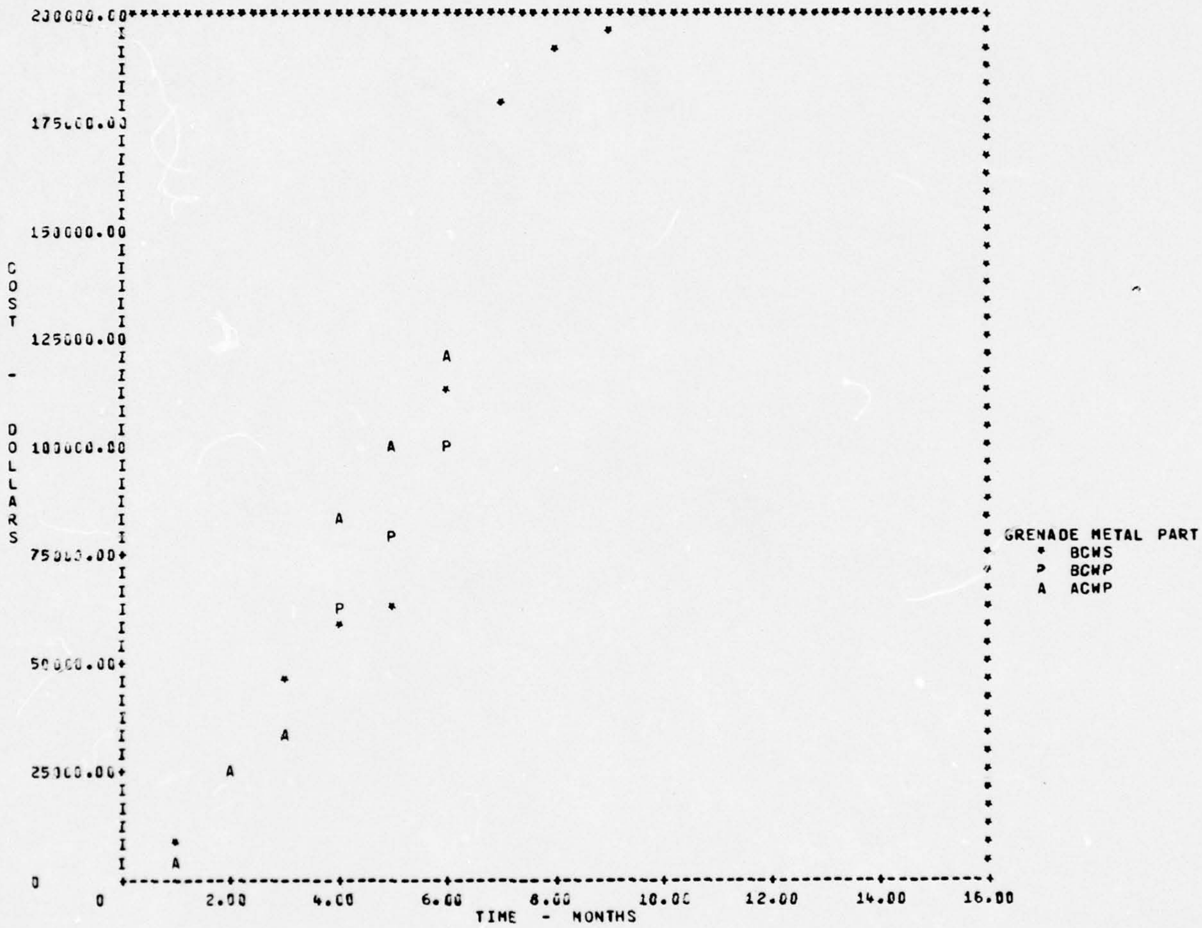
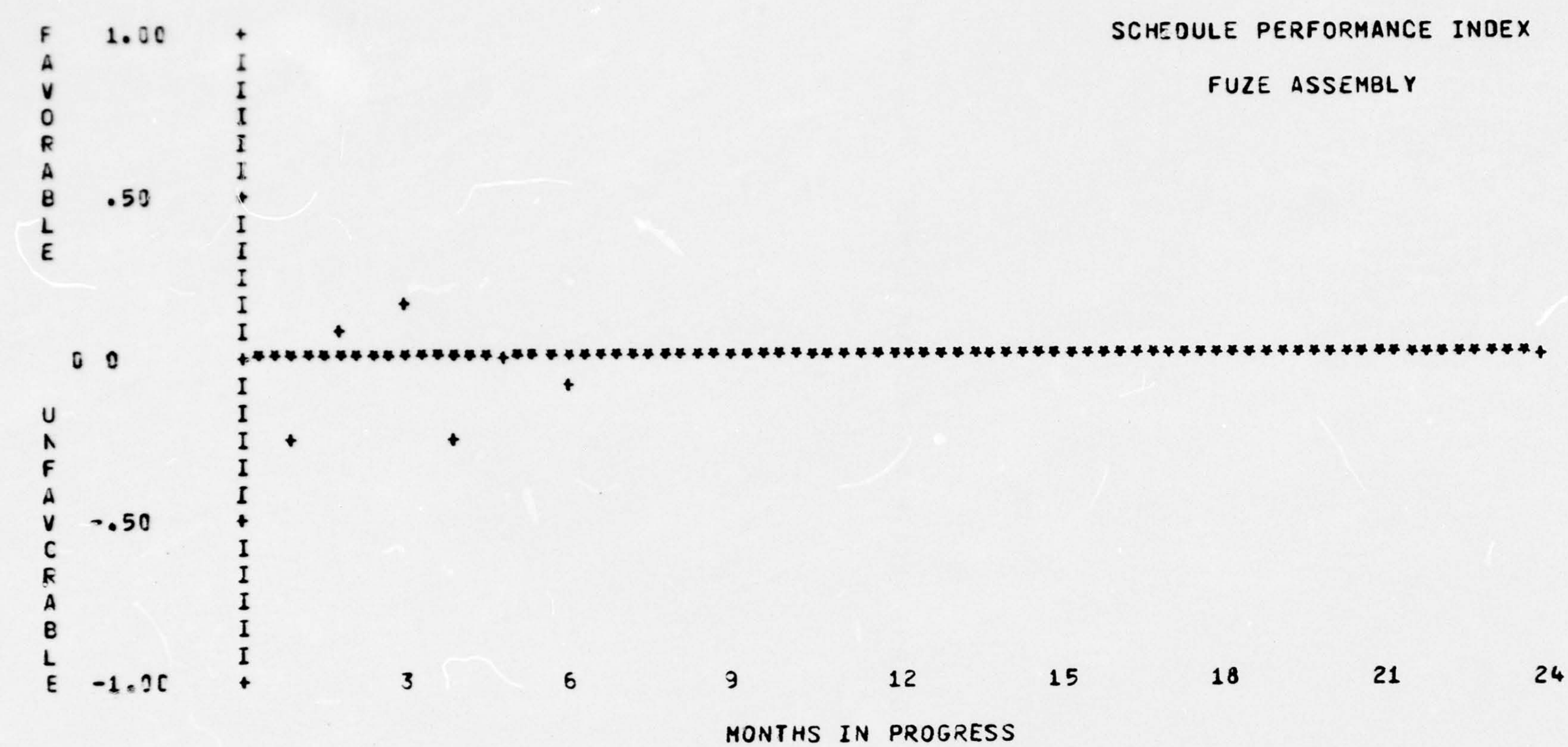
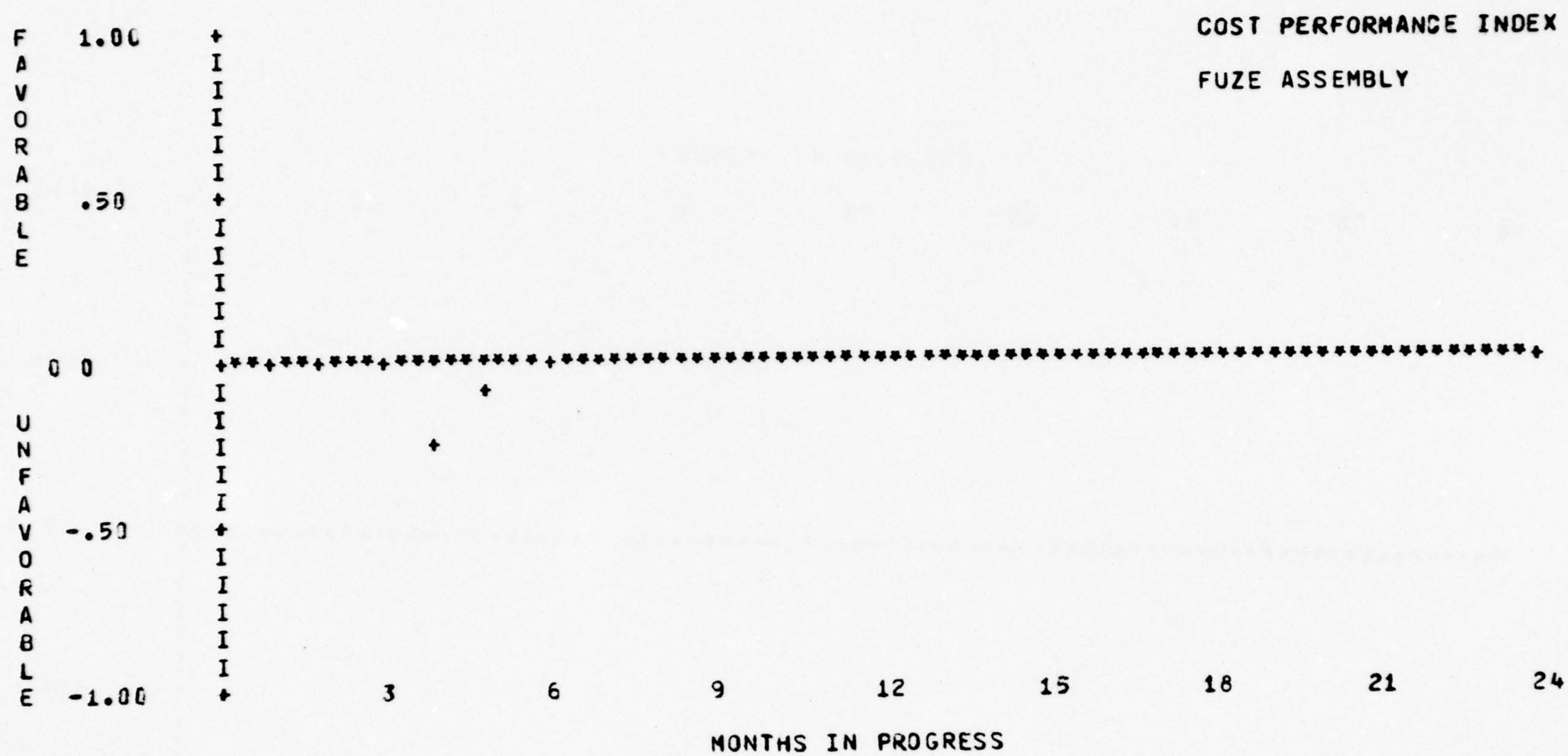
0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS

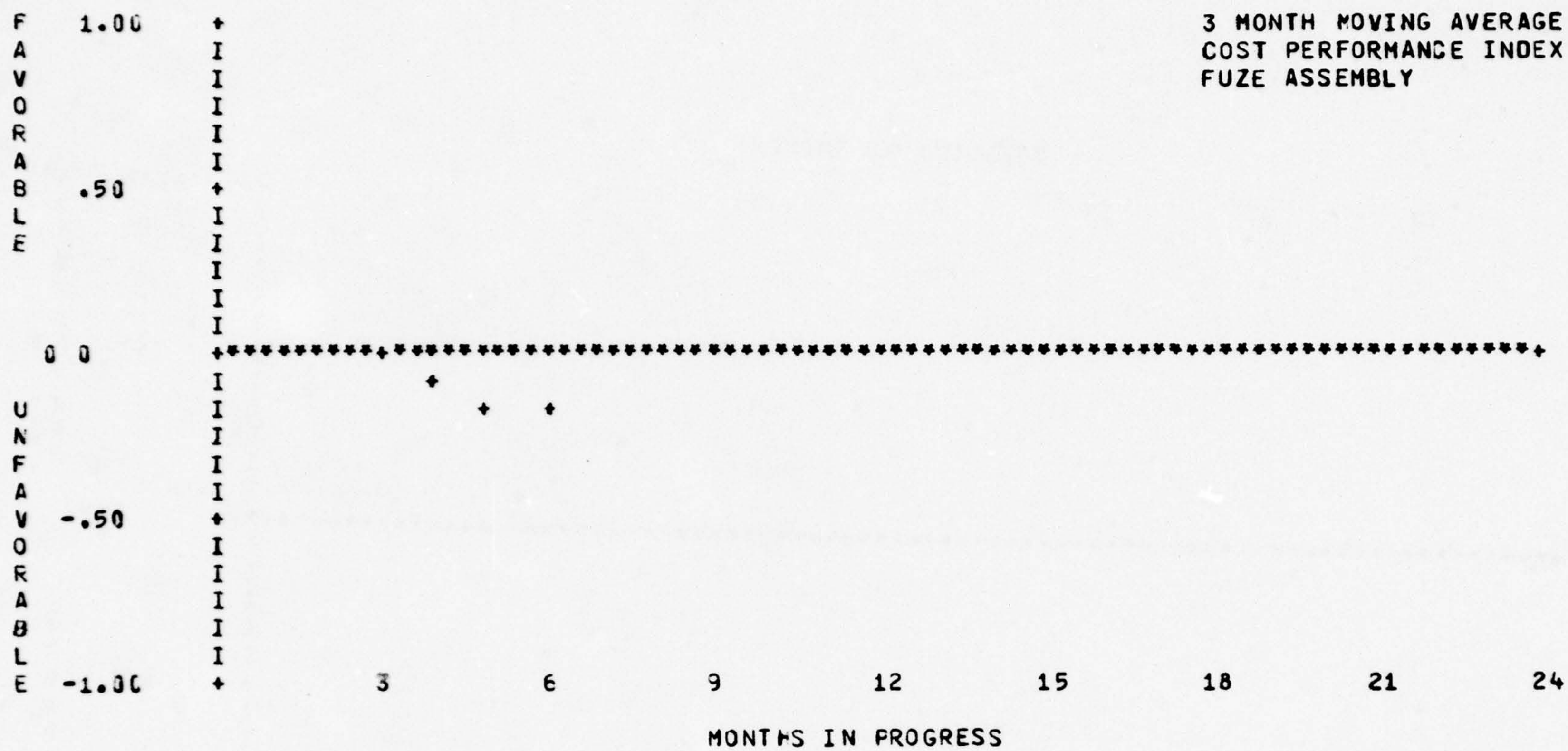


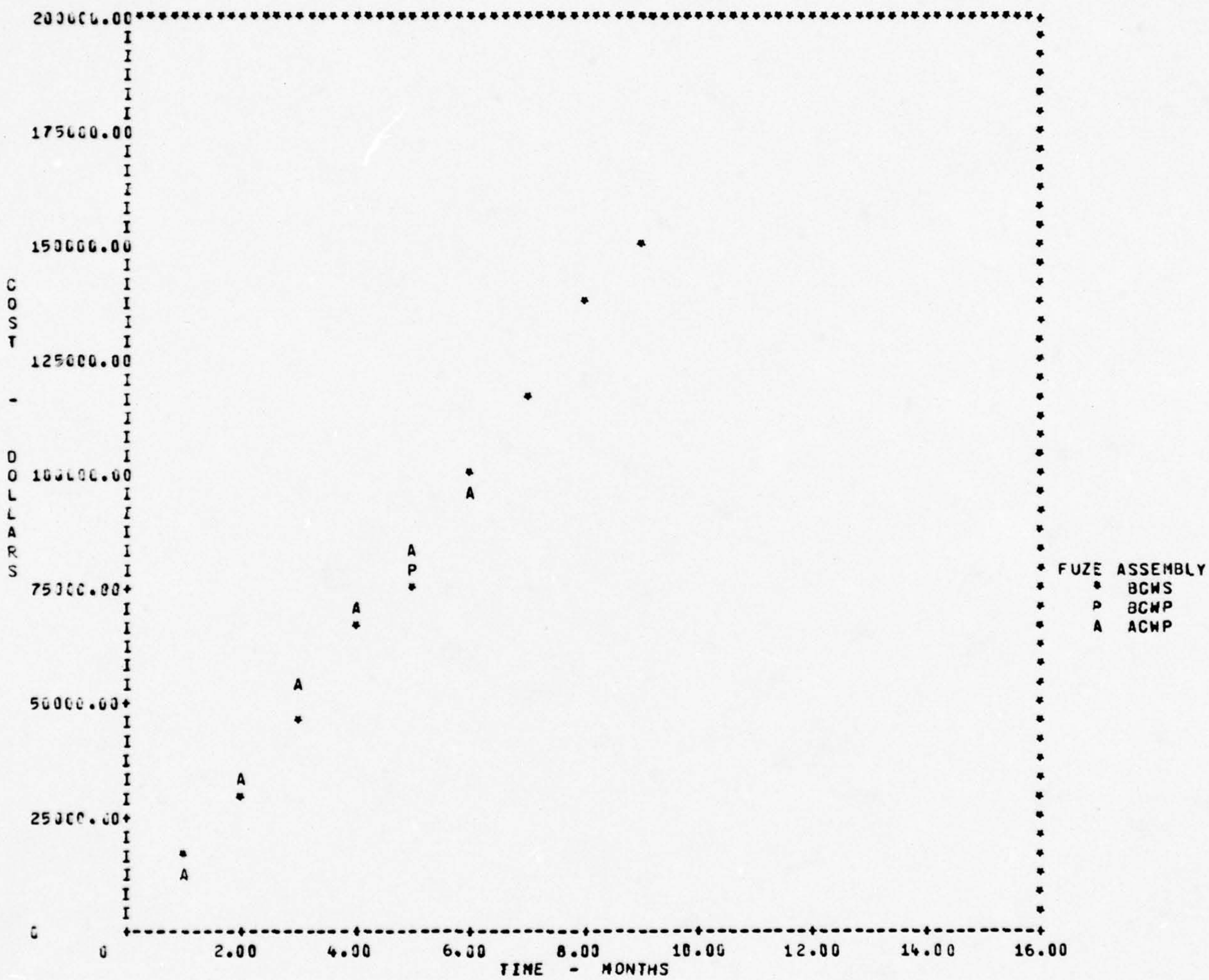
200000.00
175000.00
150000.00
125000.00
100000.00
75000.00
50000.00
25000.00
0
COST - DOLLARS
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
GRENADE METAL PART
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT FUZE ASSEMBLY

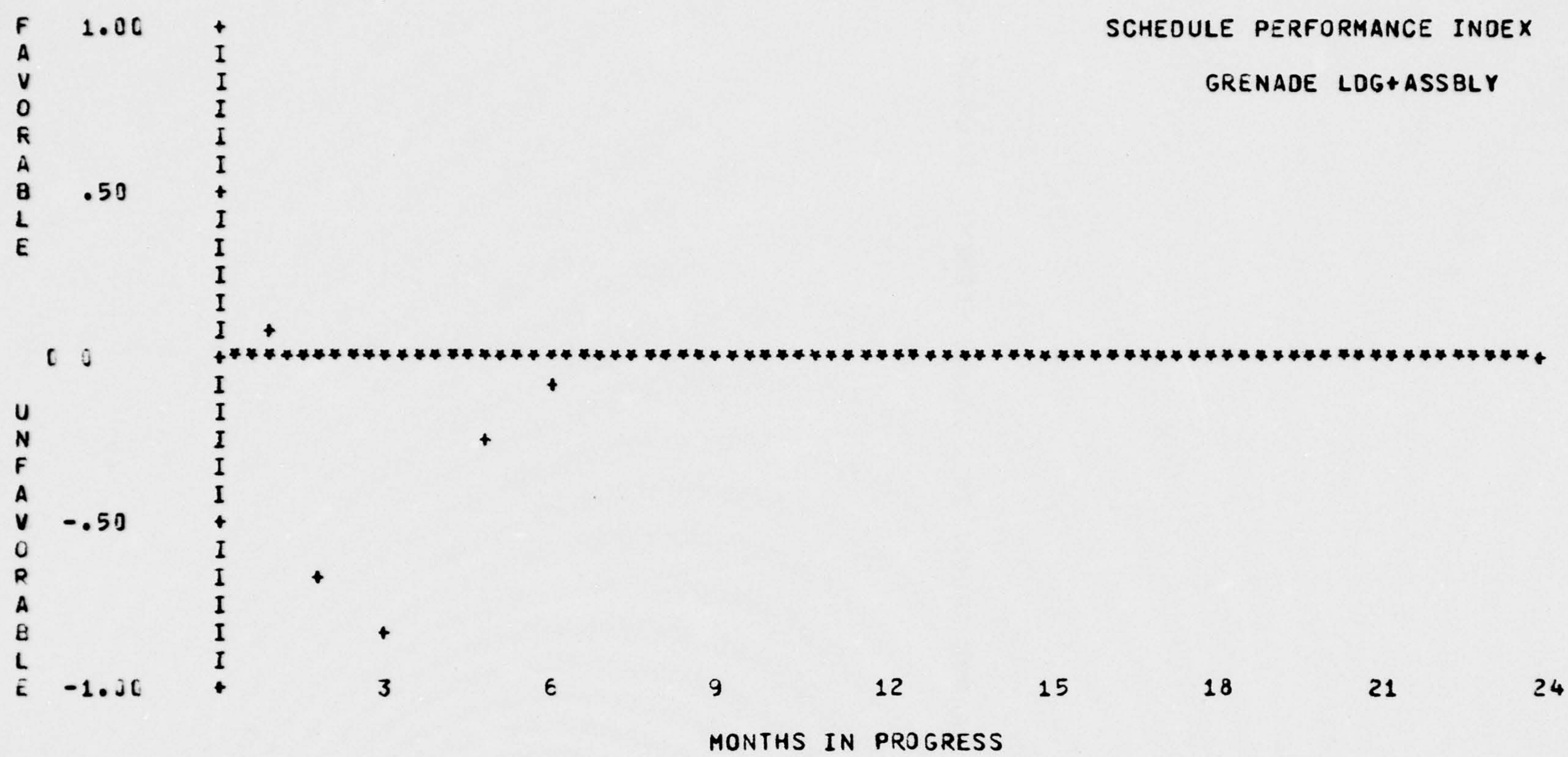

SCHEDULE PERFORMANCE INDEX
FUZE ASSEMBLY
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
FUZE ASSEMBLY
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
FUZE ASSEMBLY
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


200000.00
175000.00
150000.00
125000.00
100000.00
75000.00
50000.00
25000.00
0
C
O
S
T
-
D
O
L
L
A
R
S
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
FUZE ASSEMBLY
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT GRENADE LOG+ASSBLY


SCHEDULE PERFORMANCE INDEX
GRENADE LDG+ASSBLY
FAVORABLE
UNFAVORABLE
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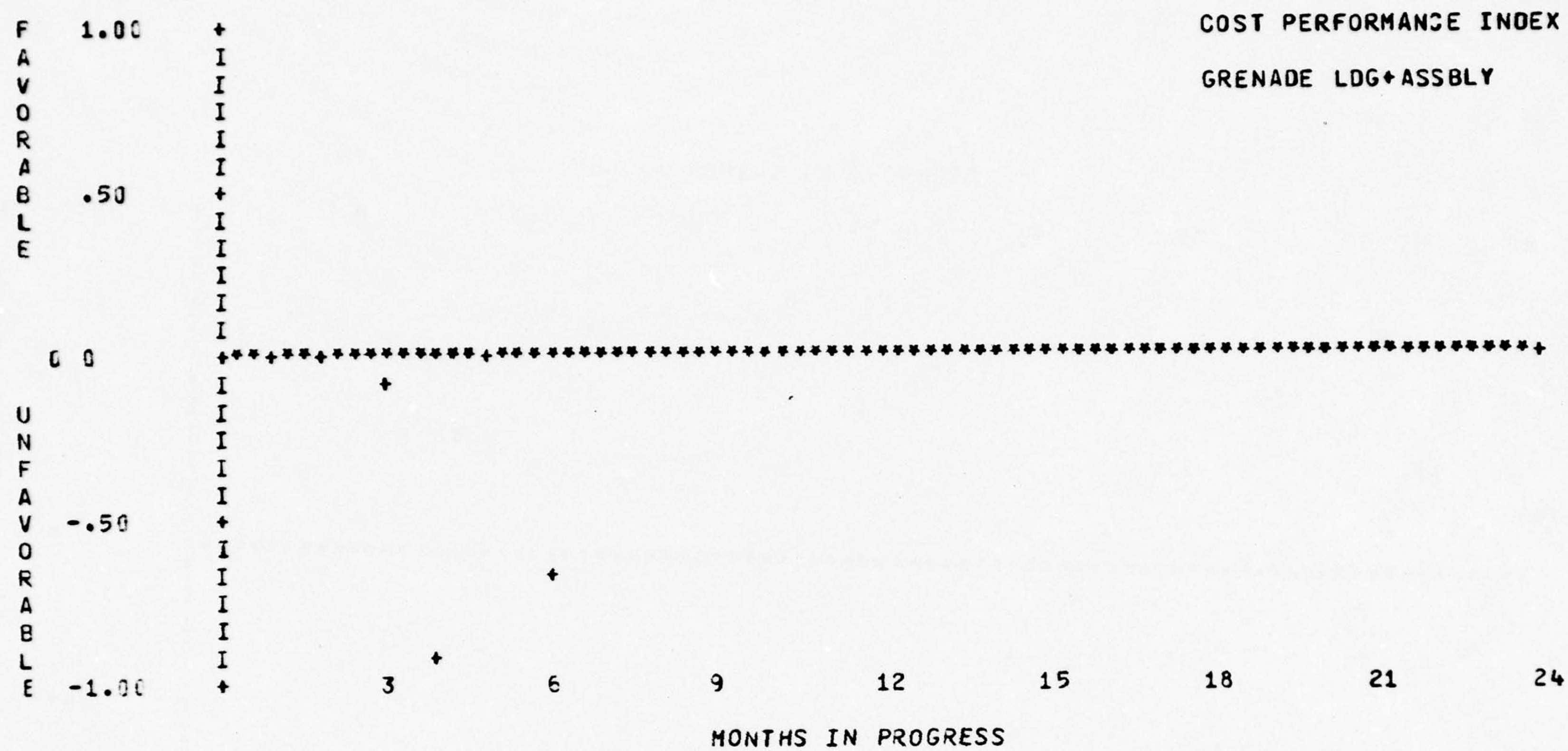
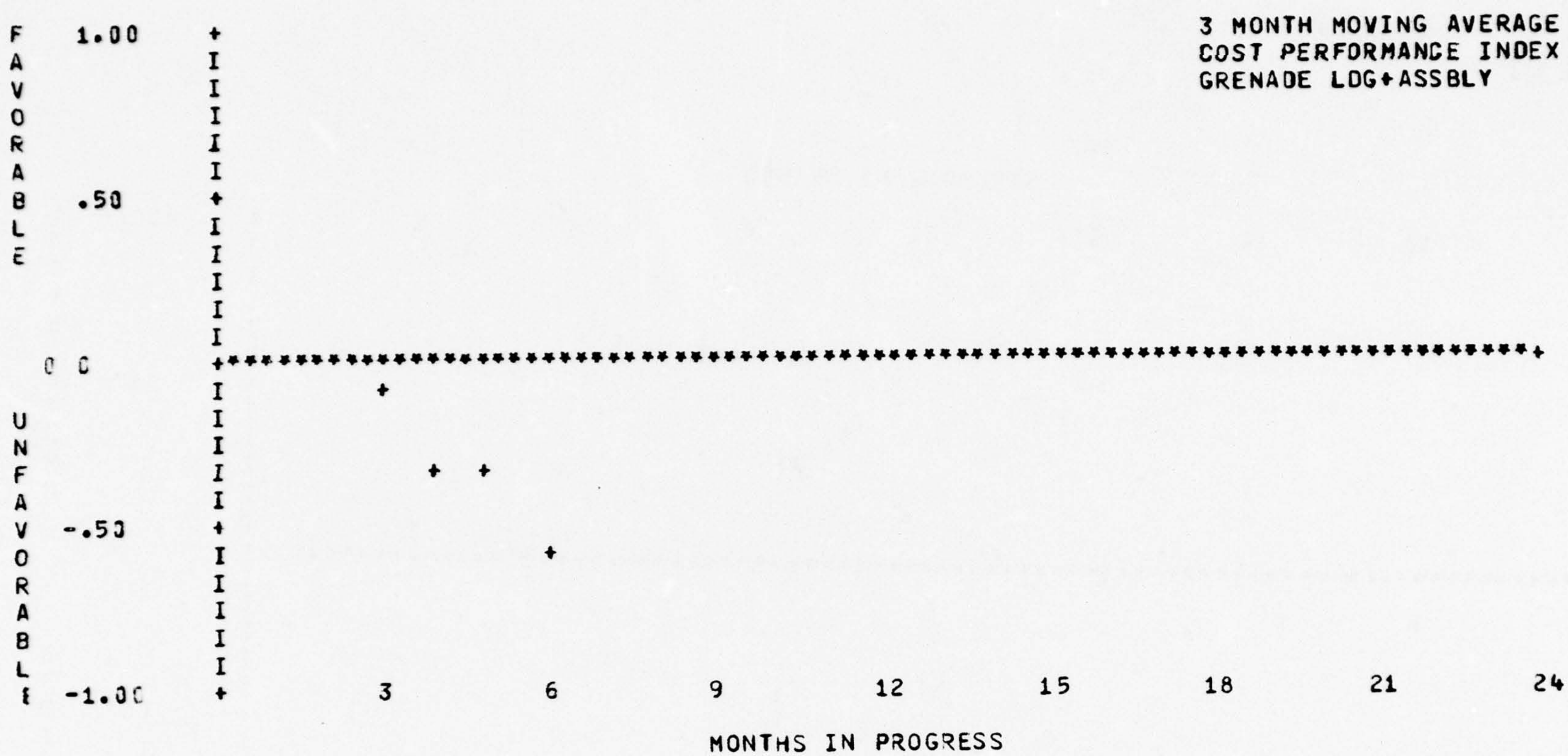
.50
0.0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
GRENADE LDG+ASSBLY
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
GRENADE LDG+ASSBLY
FAVORABLE
UNFAVORABLE
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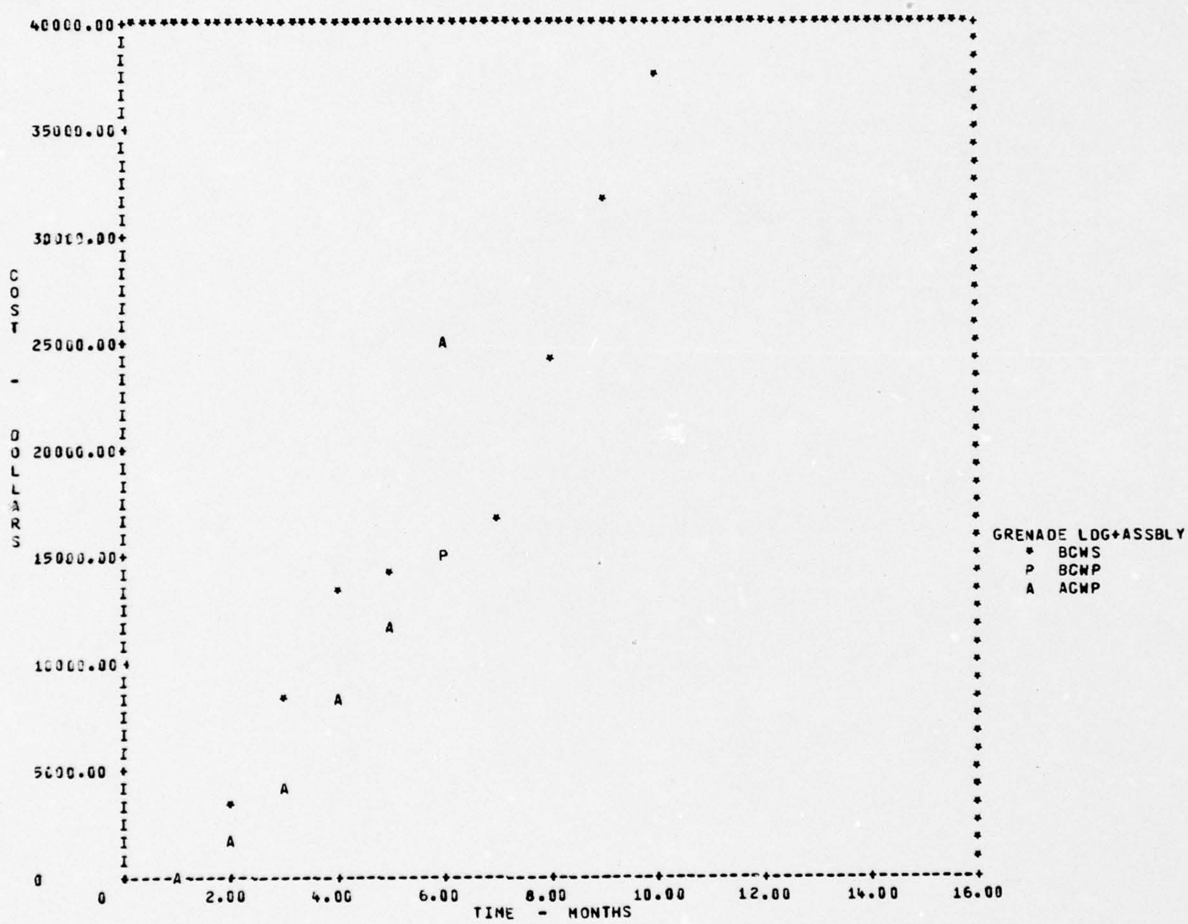
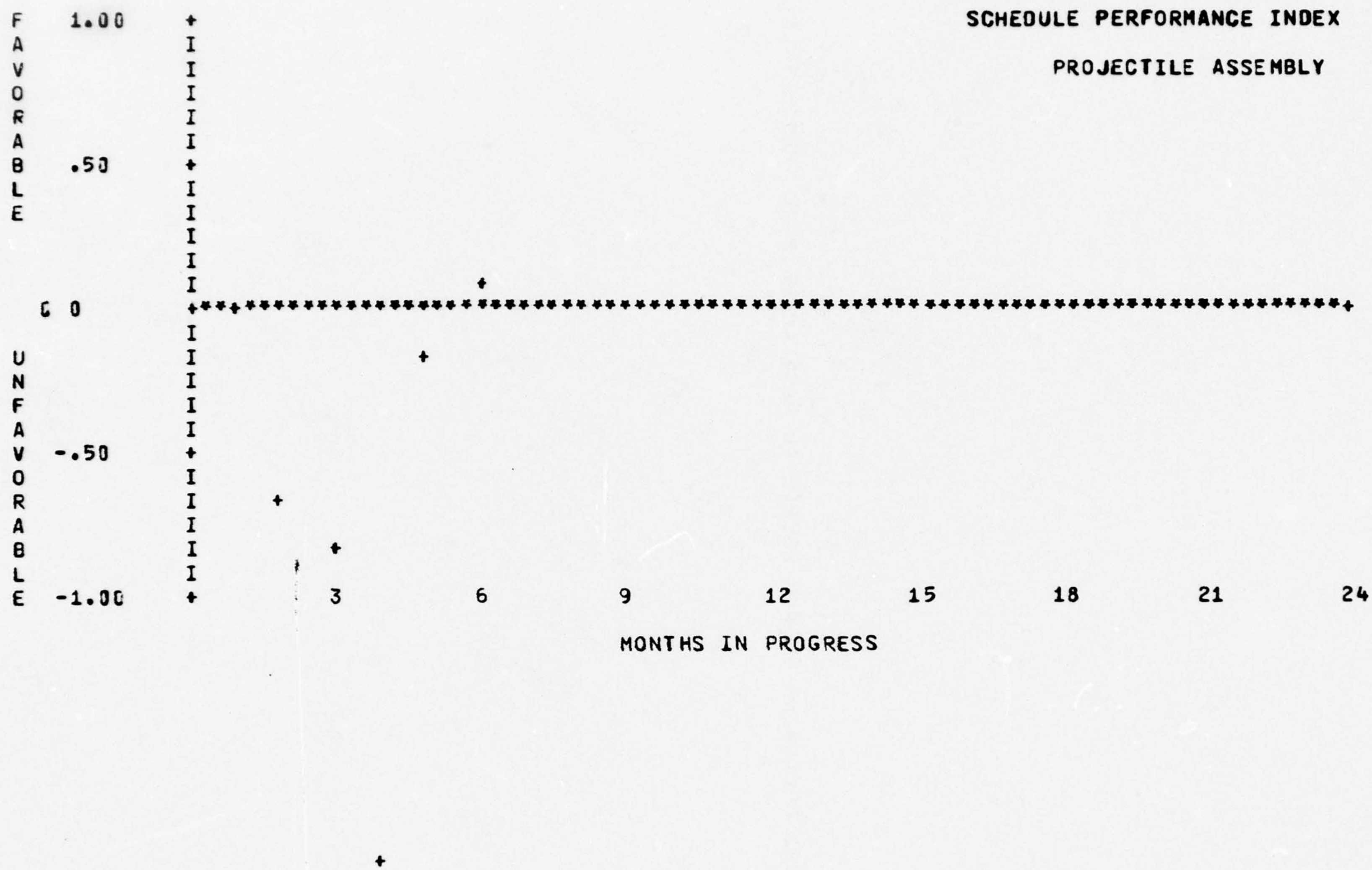
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS



40000.00
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0
COST - DOLLARS
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
GRENADE LDG+ASSBLY
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT PROJECTILE ASSEMBLY


SCHEDULE PERFORMANCE INDEX
PROJECTILE ASSEMBLY
FAVORABLE
1.00
.50
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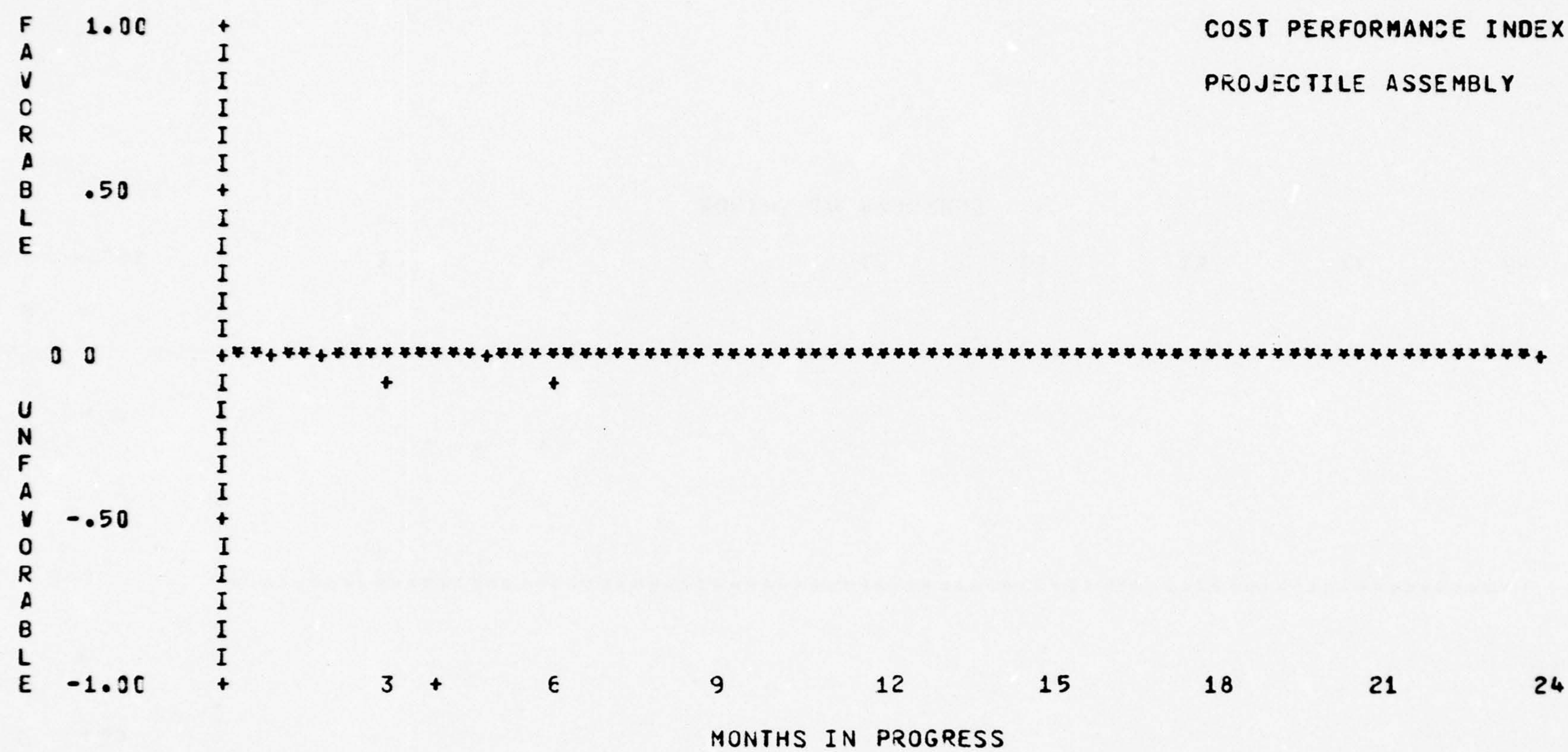
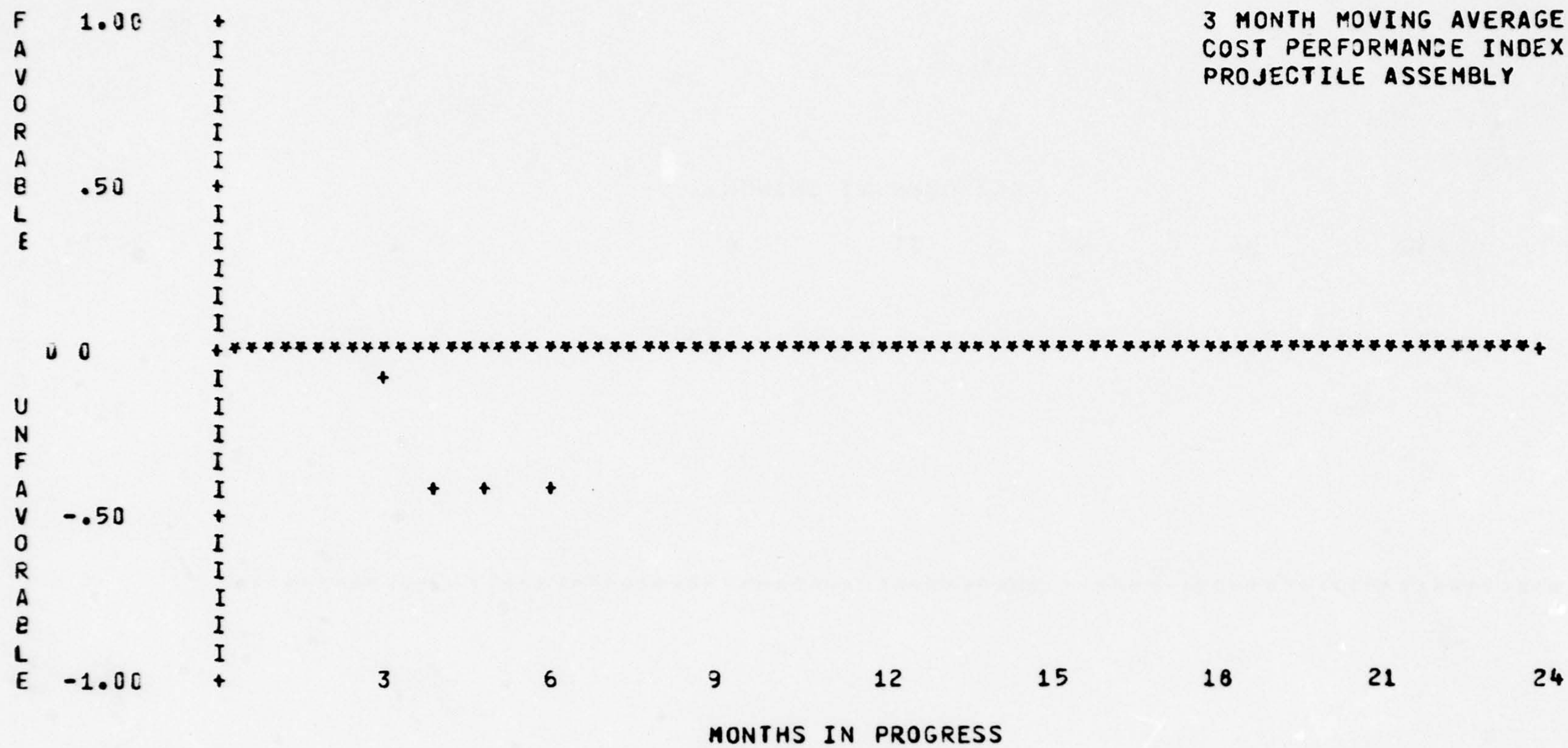
UNFAVORABLE
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
PROJECTILE ASSEMBLY
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
PROJECTILE ASSEMBLY
FAVORABLE
UNFAVORABLE
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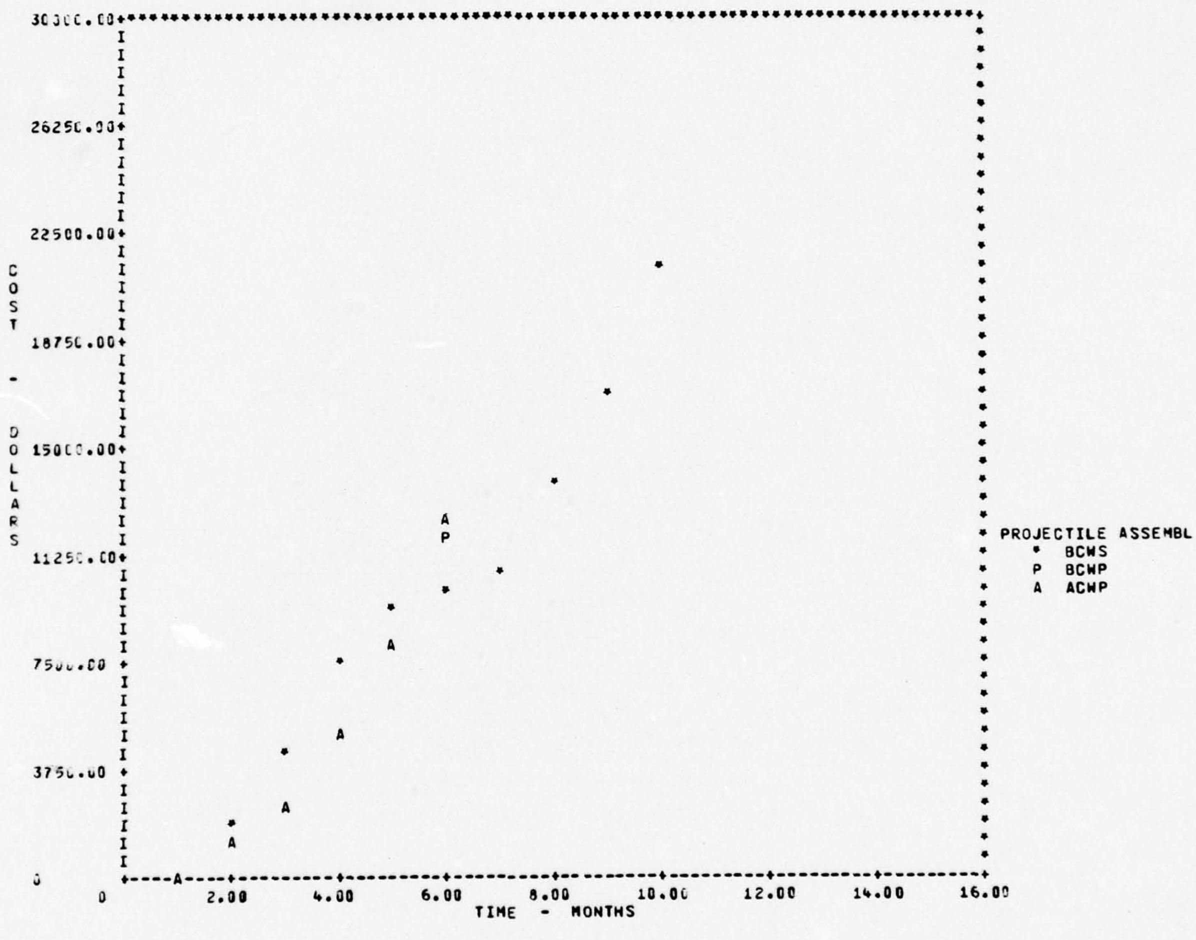
.50
0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST - DOLLARS
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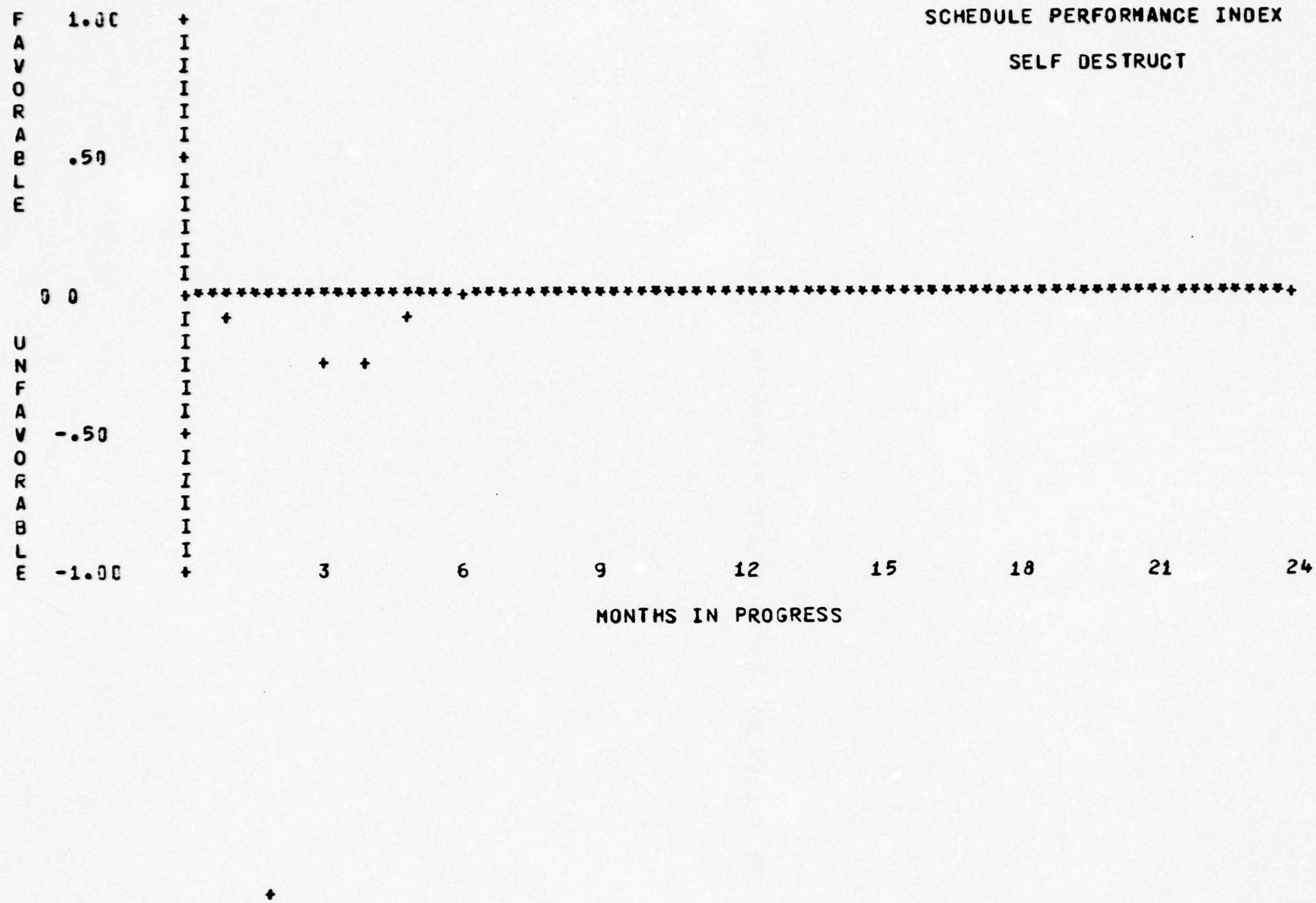
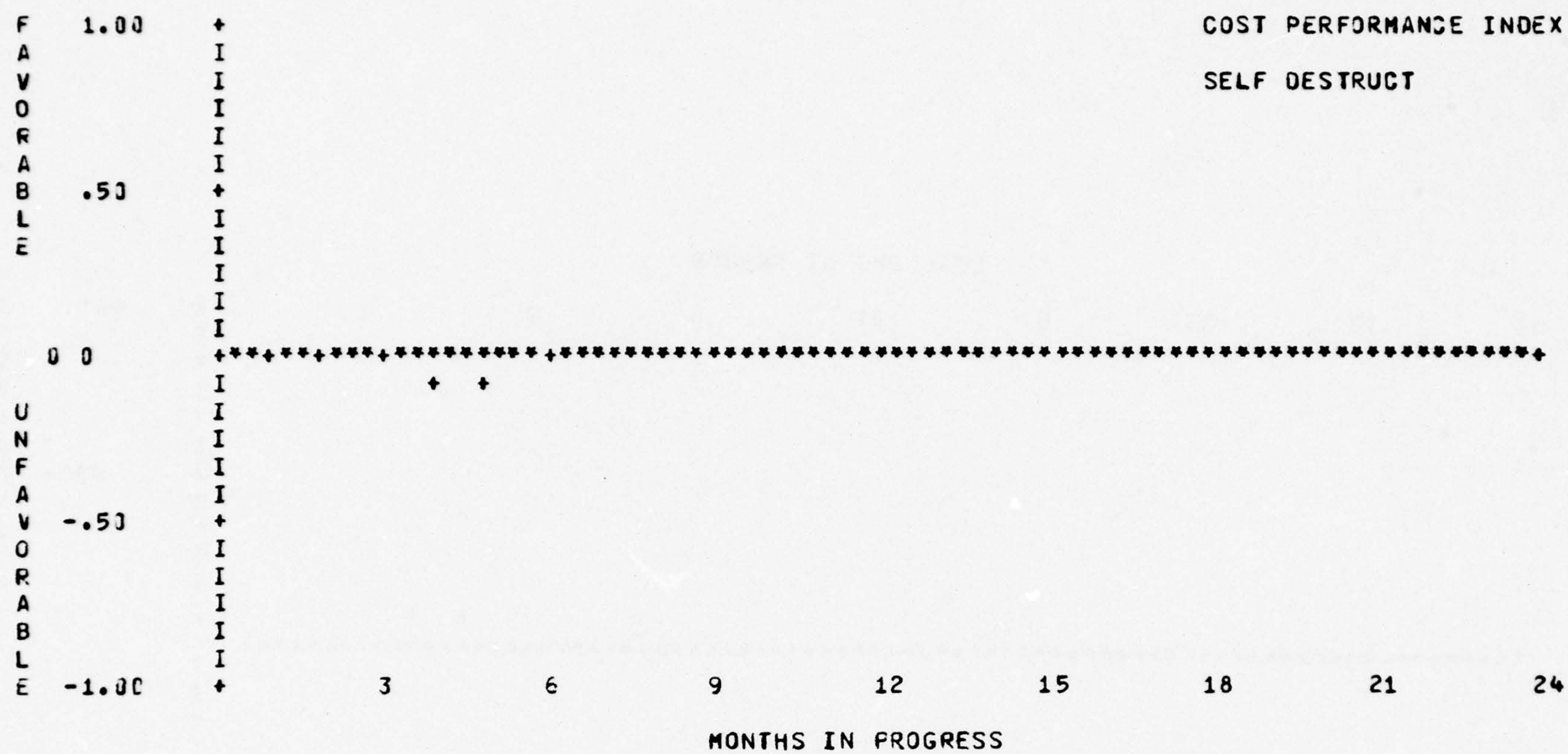
26250.00
22500.00
18750.00
15000.00
11250.00
7500.00
3750.00
0
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
PROJECTILE ASSEMBL
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT SELF DESTRUCT


SCHEDULE PERFORMANCE INDEX
SELF DESTRUCT
FAVORABLE
UNFAVORABLE
1.00
.50
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
SELF DESTRUCT
FAVORABLE
UNFAVORABLE
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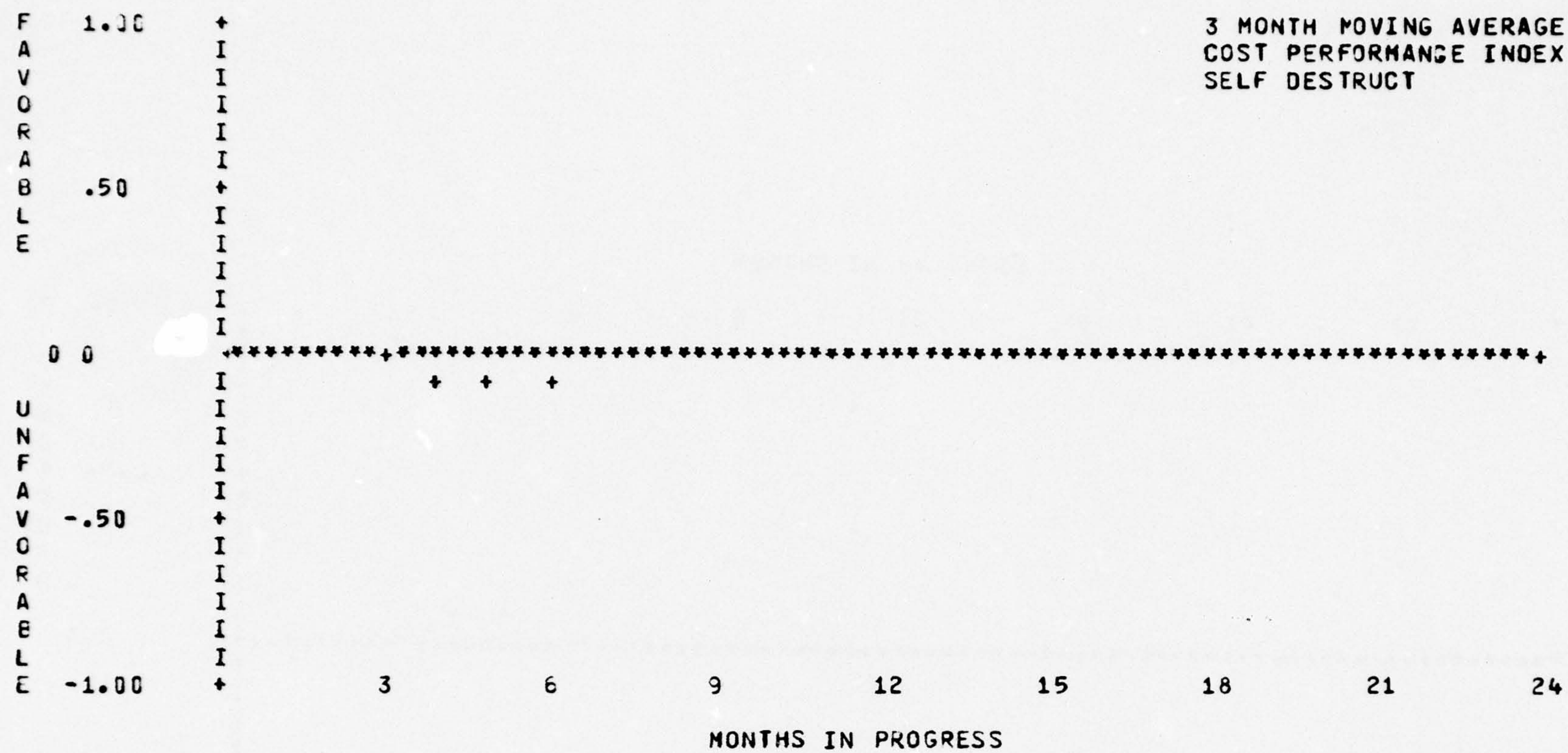
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
SELF DESTRUCT
FAVORABLE
UNFAVORABLE
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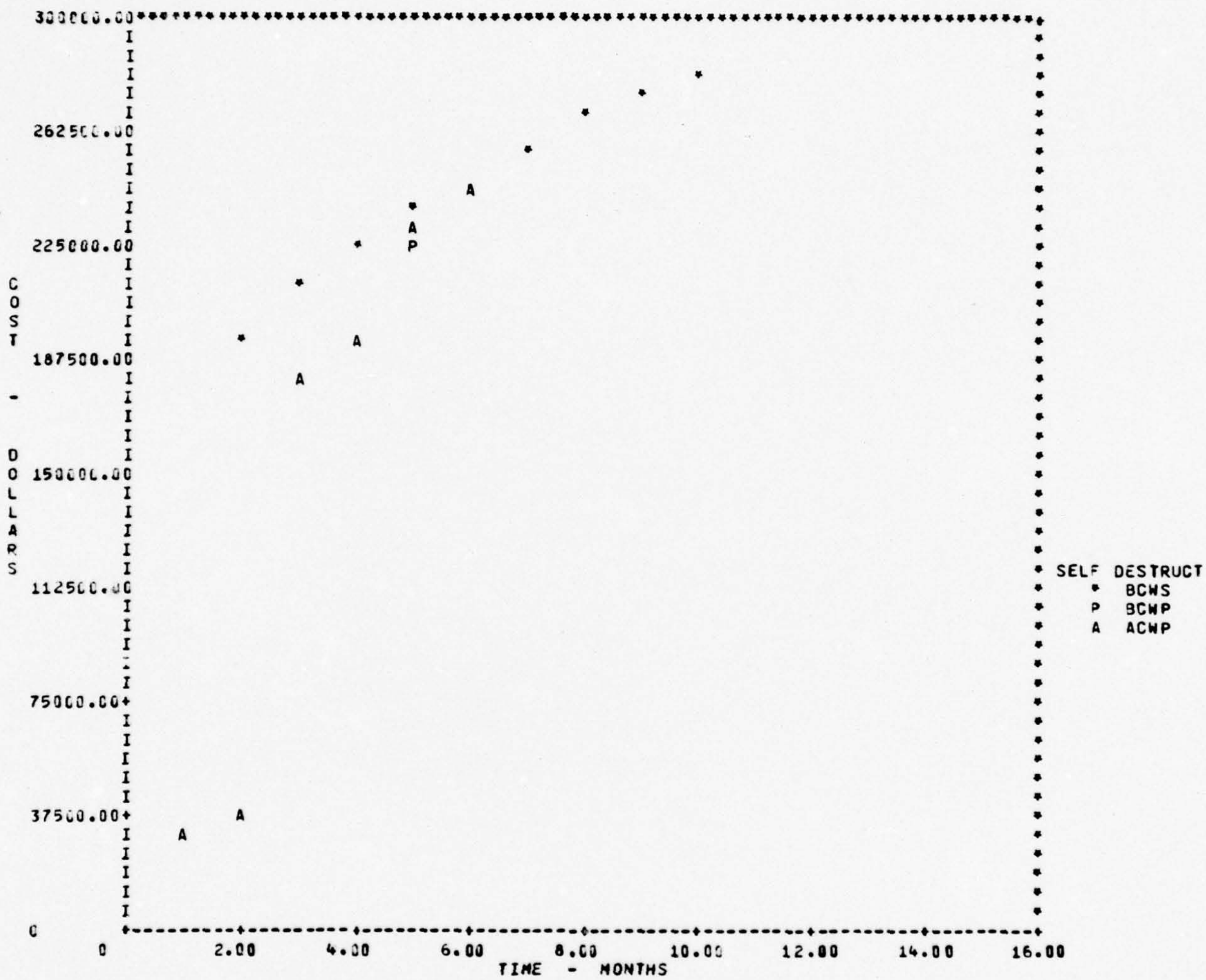
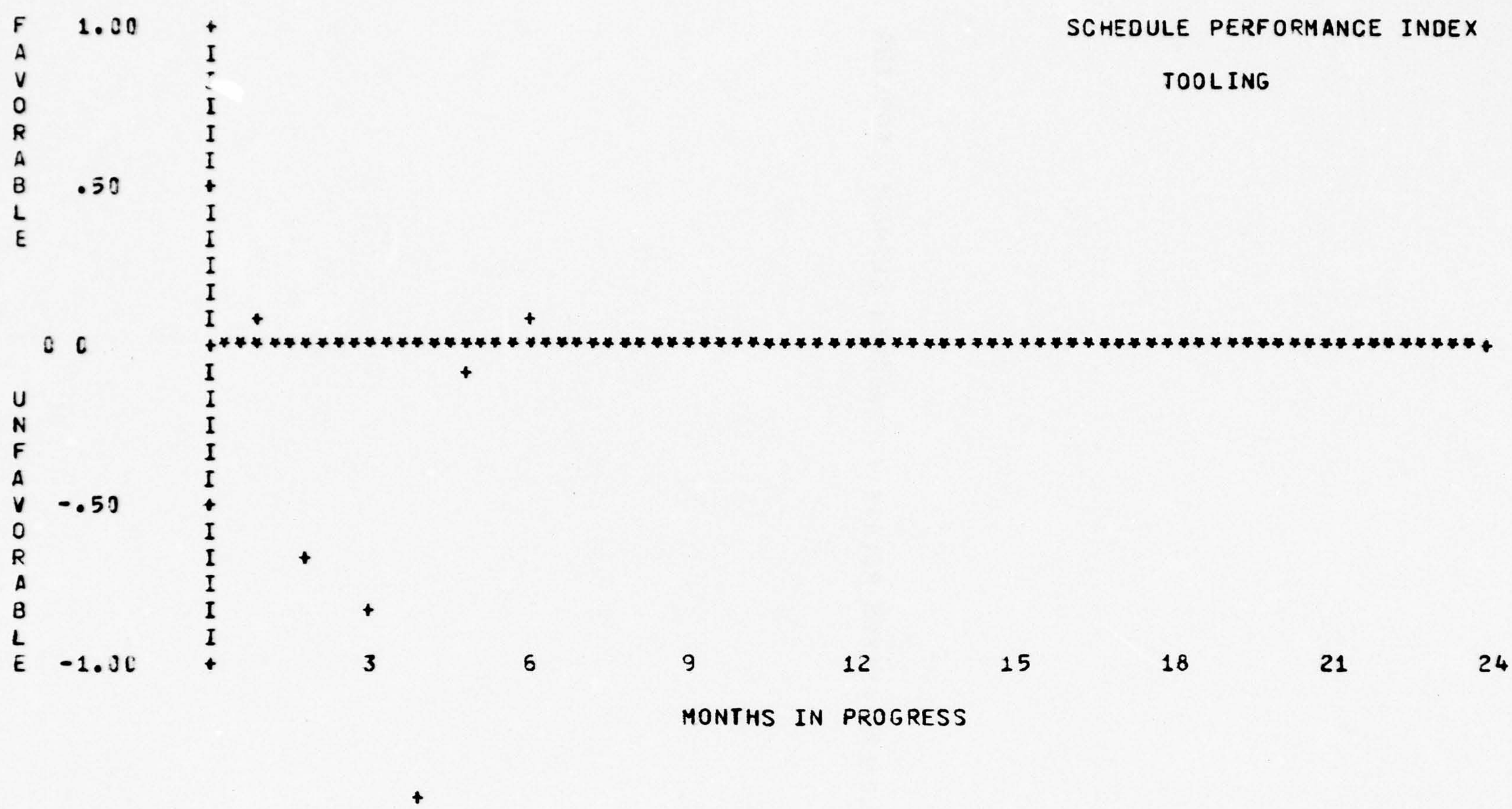
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


300000.00
262500.00
225000.00
187500.00
150000.00
112500.00
75000.00
37500.00
0
COST - DOLLARS
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
SELF DESTRUCT
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT TOOLING


SCHEDULE PERFORMANCE INDEX
TOOLING
FAVORABLE
UNFAVORABLE
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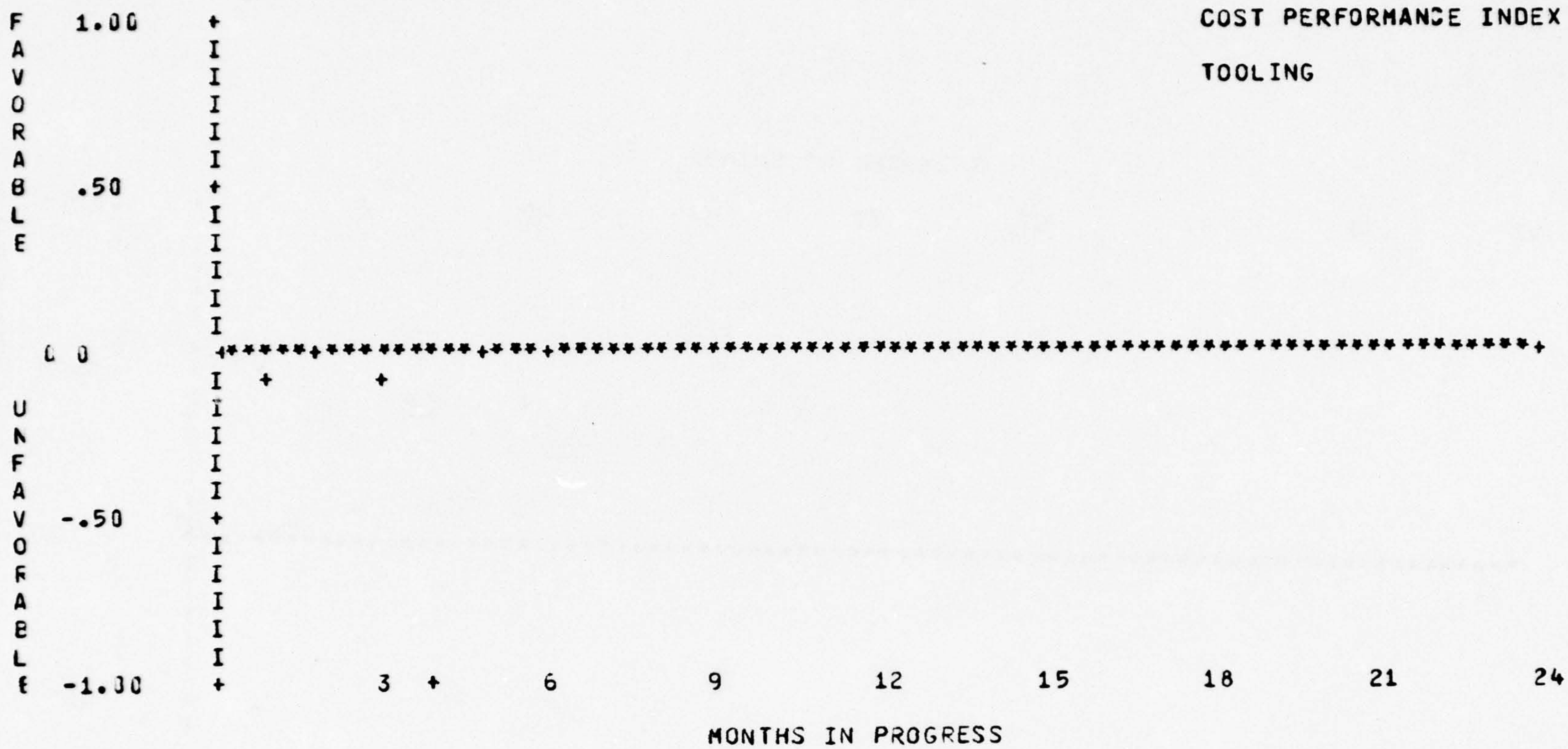
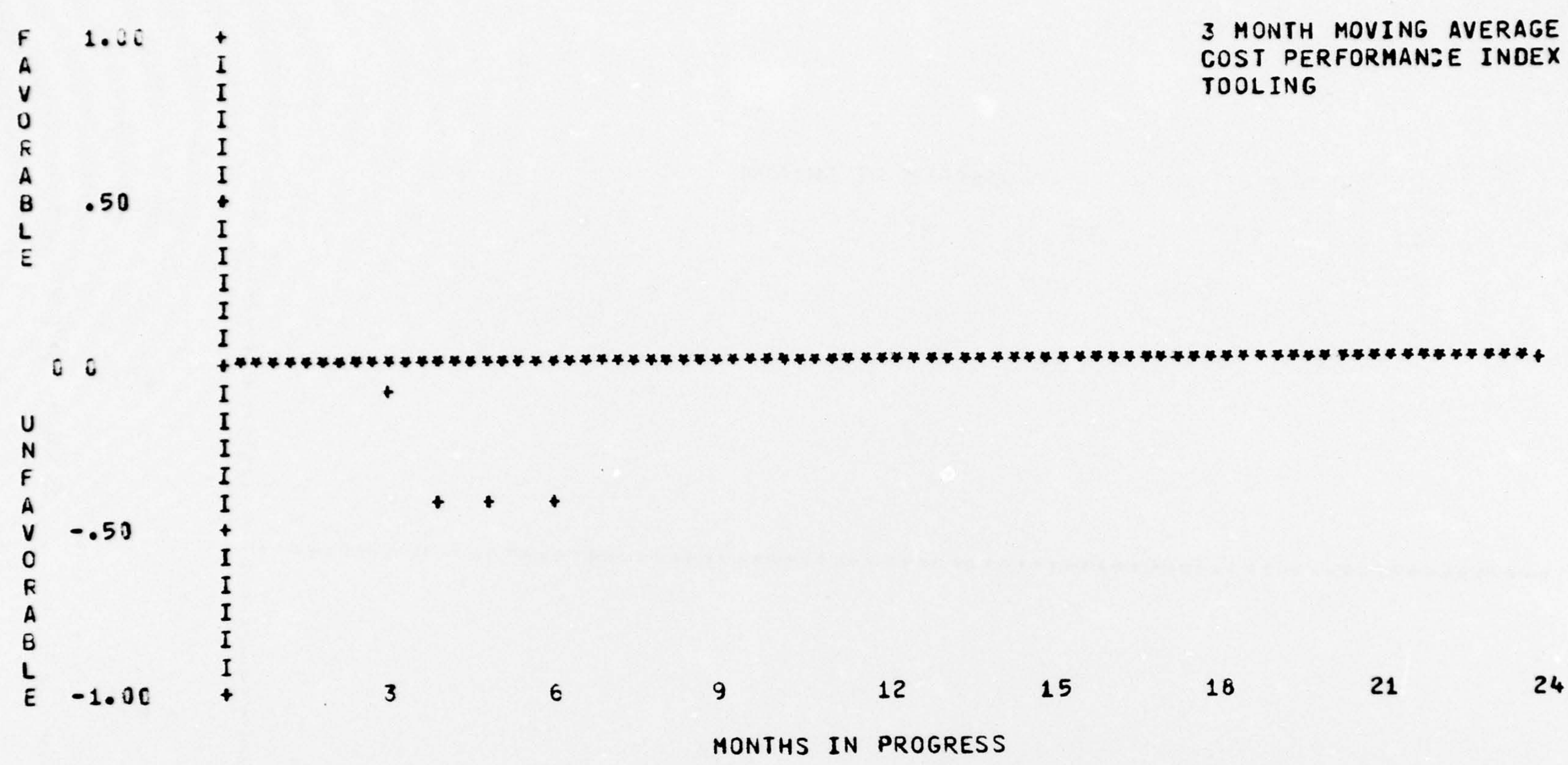
0 0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS



COST PERFORMANCE INDEX
TOOLING
FAVORABLE
UNFAVORABLE
1.00
.50
0
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
TOOLING
FAVORABLE
UNFAVORABLE
1.00
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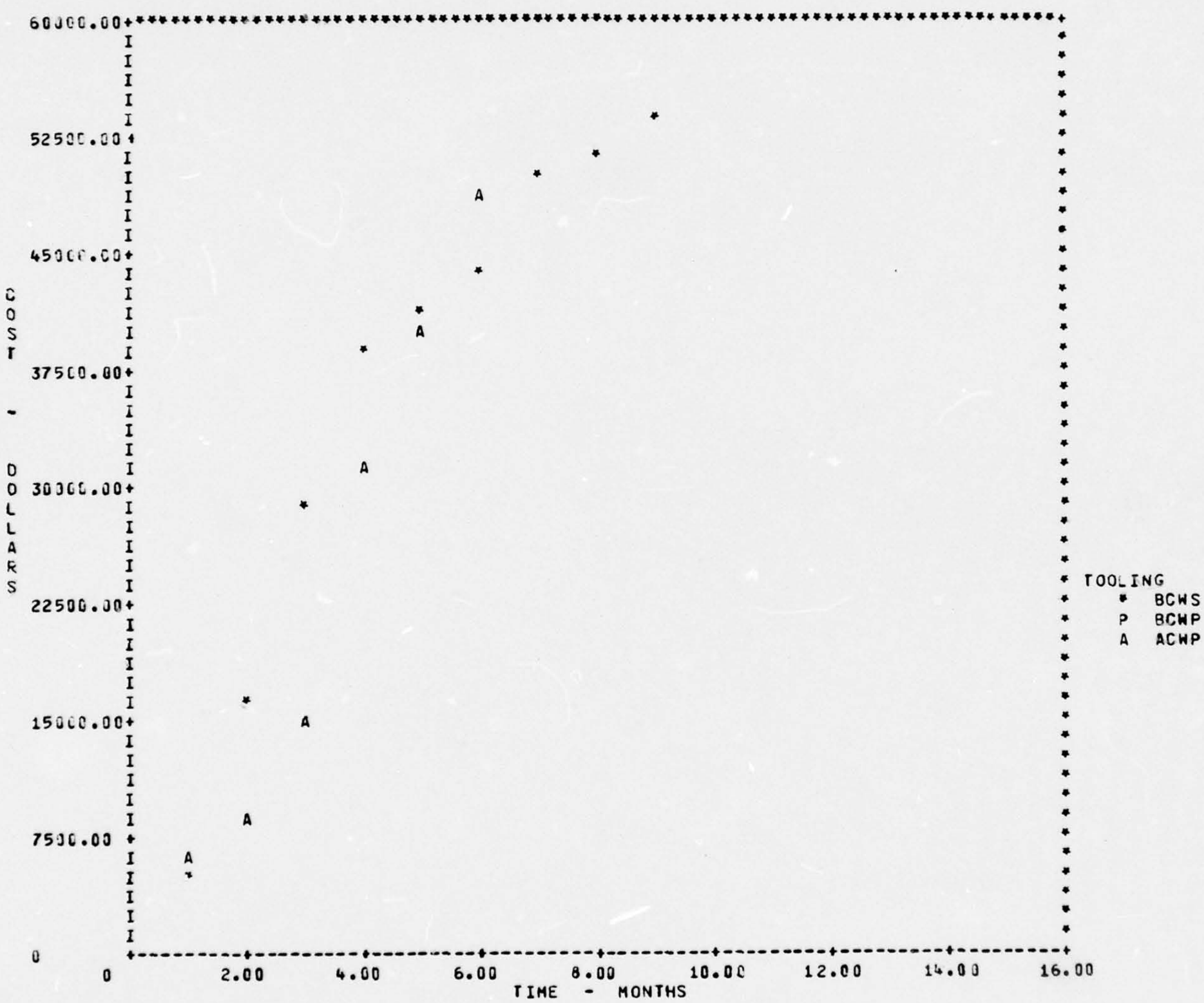
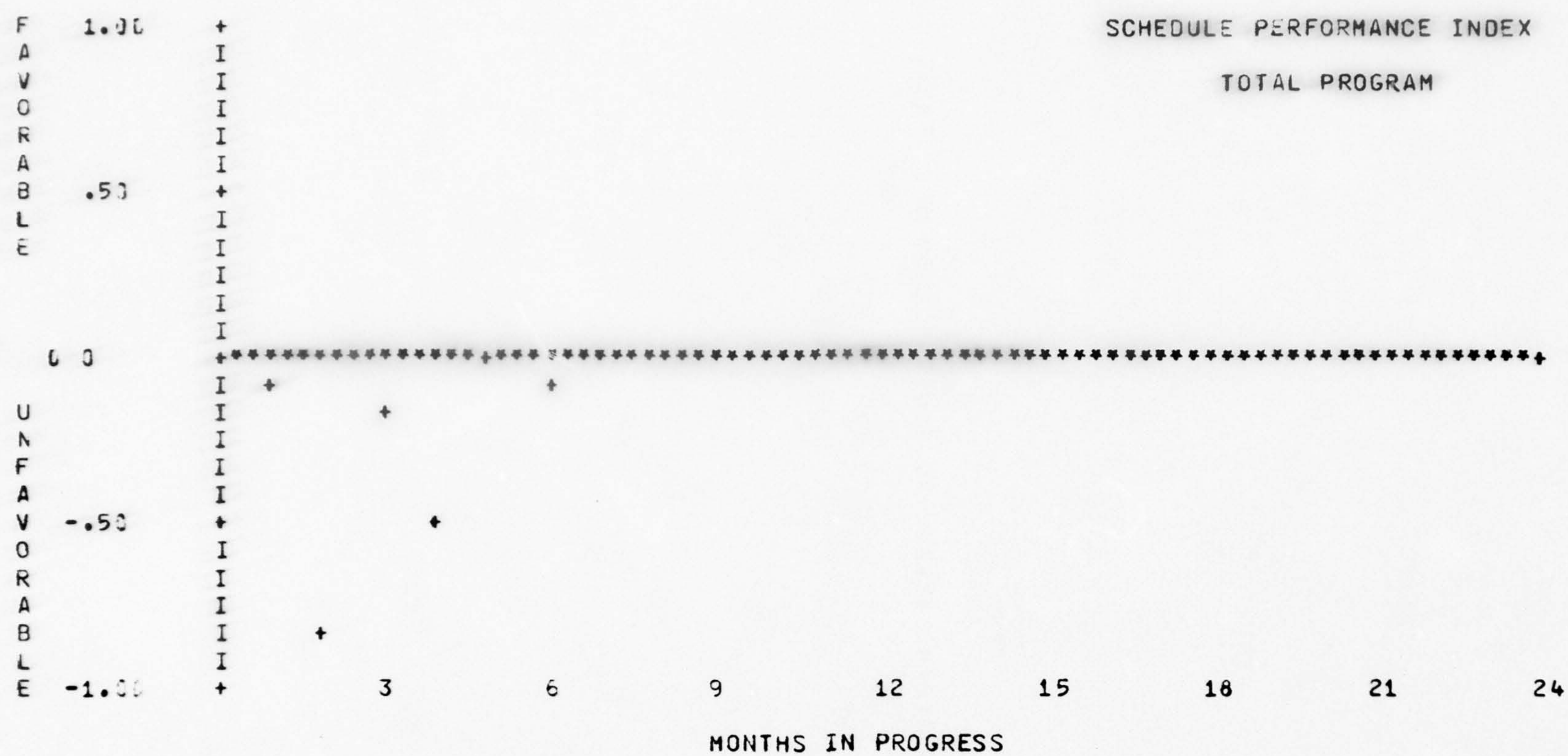
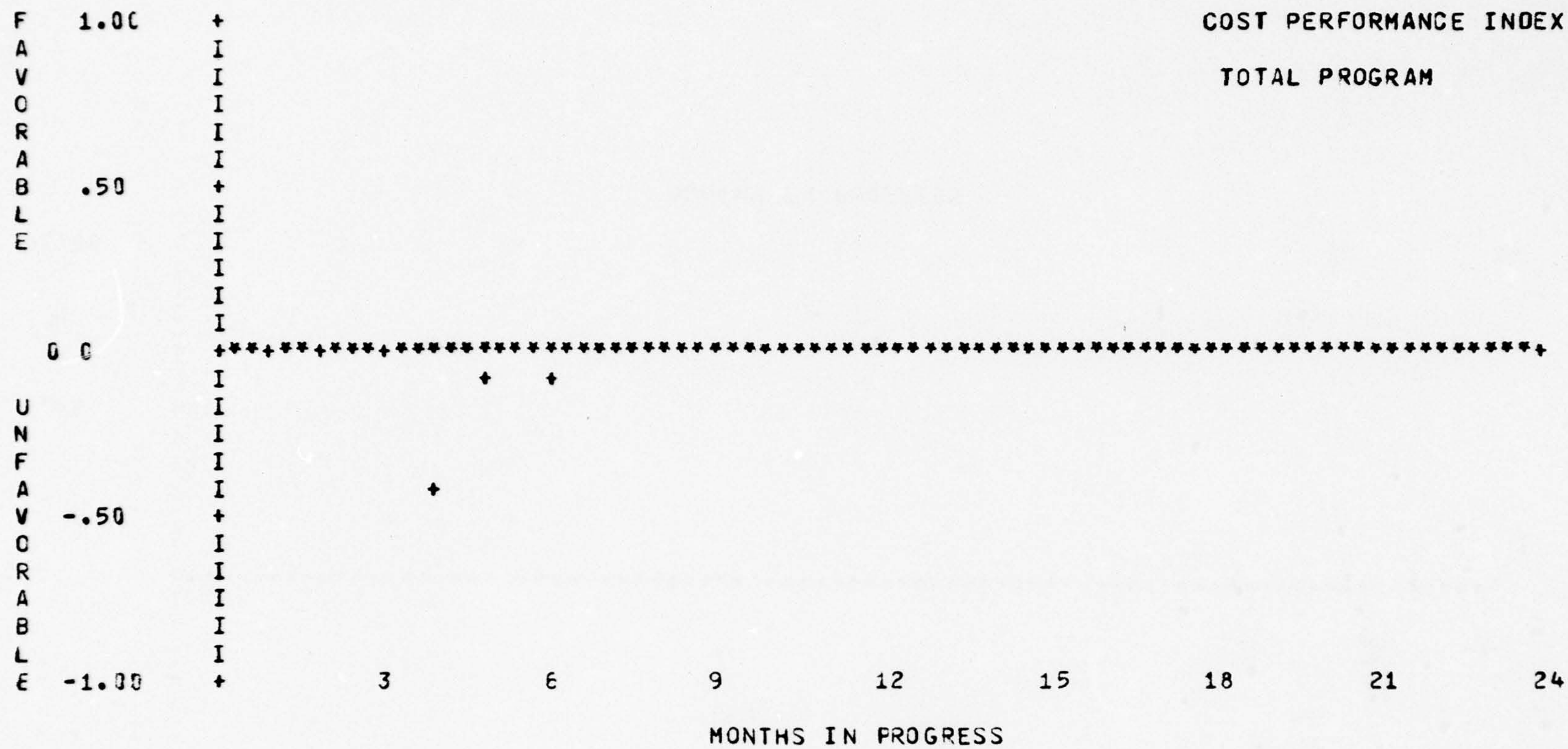
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS



60000.00
52500.00
45000.00
37500.00
30000.00
22500.00
15000.00
7500.00
0
COST - DOLLARS
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
TOOLING
* BCWS
P BCWP
A ACWP

THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT TOTAL PROGRAM


SCHEDULE PERFORMANCE INDEX
TOTAL PROGRAM
FAVORABLE
1.00
.50
0.0
-.50
-1.00
UNFAVORABLE
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


COST PERFORMANCE INDEX
TOTAL PROGRAM
FAVORABLE
UNFAVORABLE
1.00
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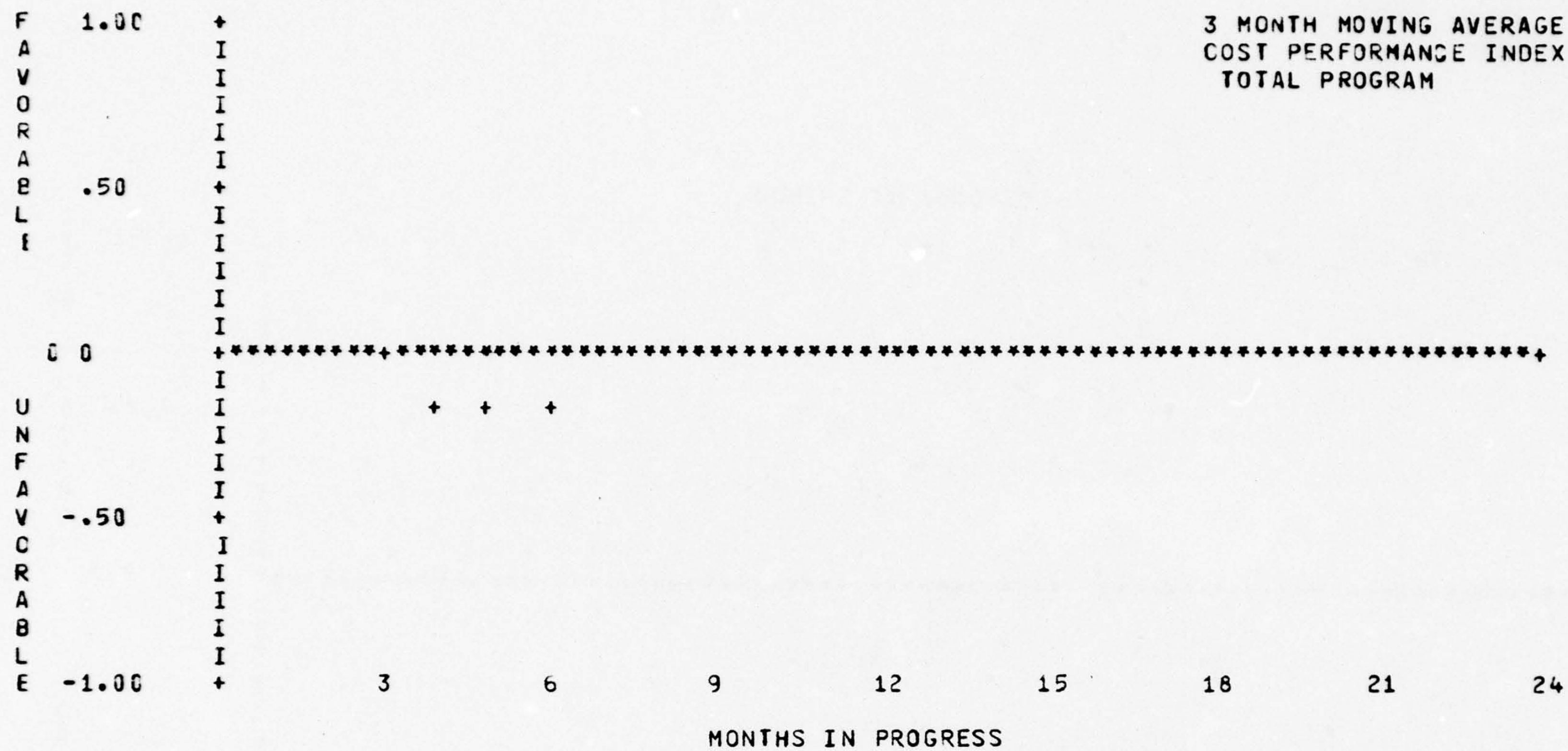
-.50
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


3 MONTH MOVING AVERAGE
COST PERFORMANCE INDEX
TOTAL PROGRAM
FAVORABLE
UNFAVORABLE
1.00
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0
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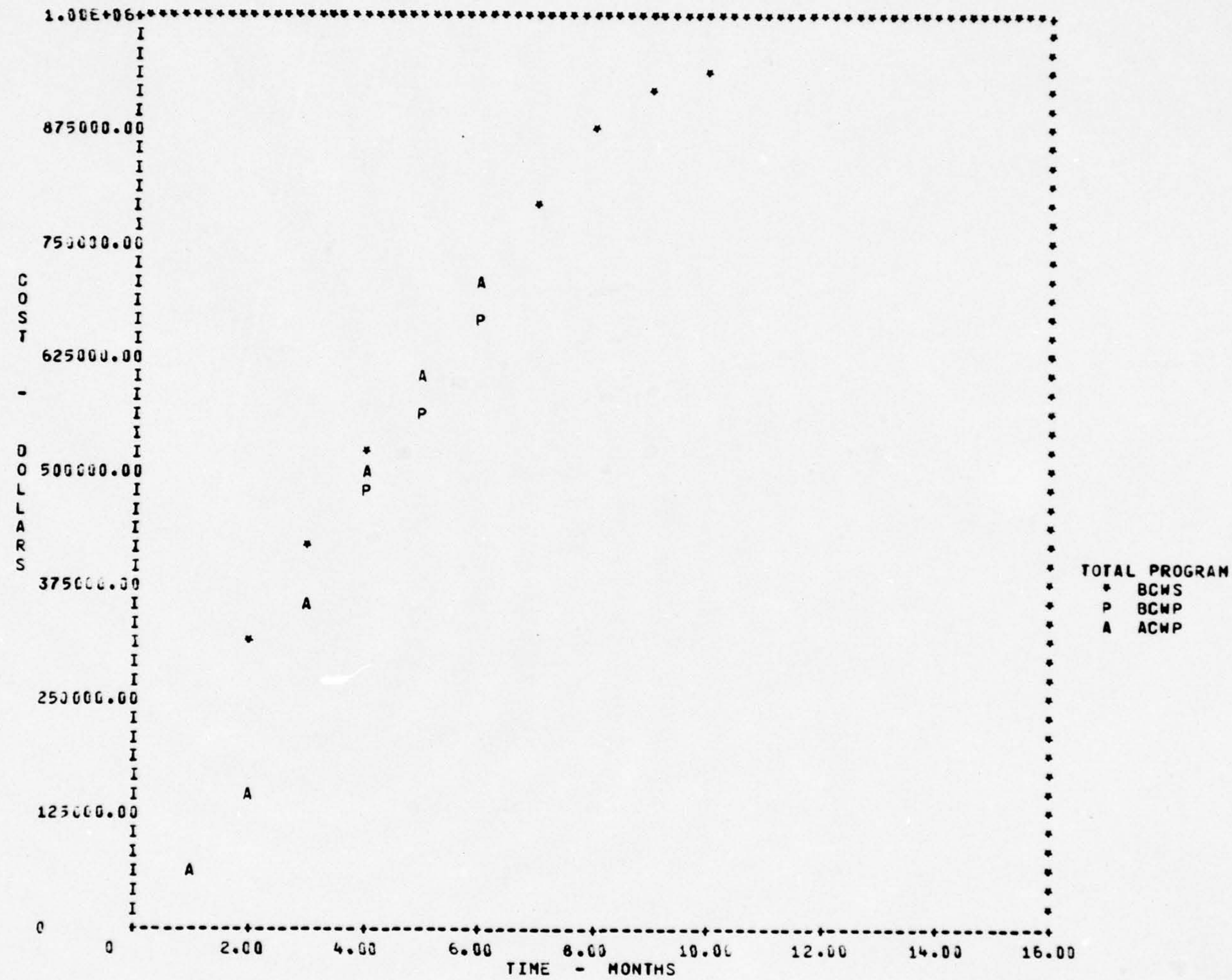
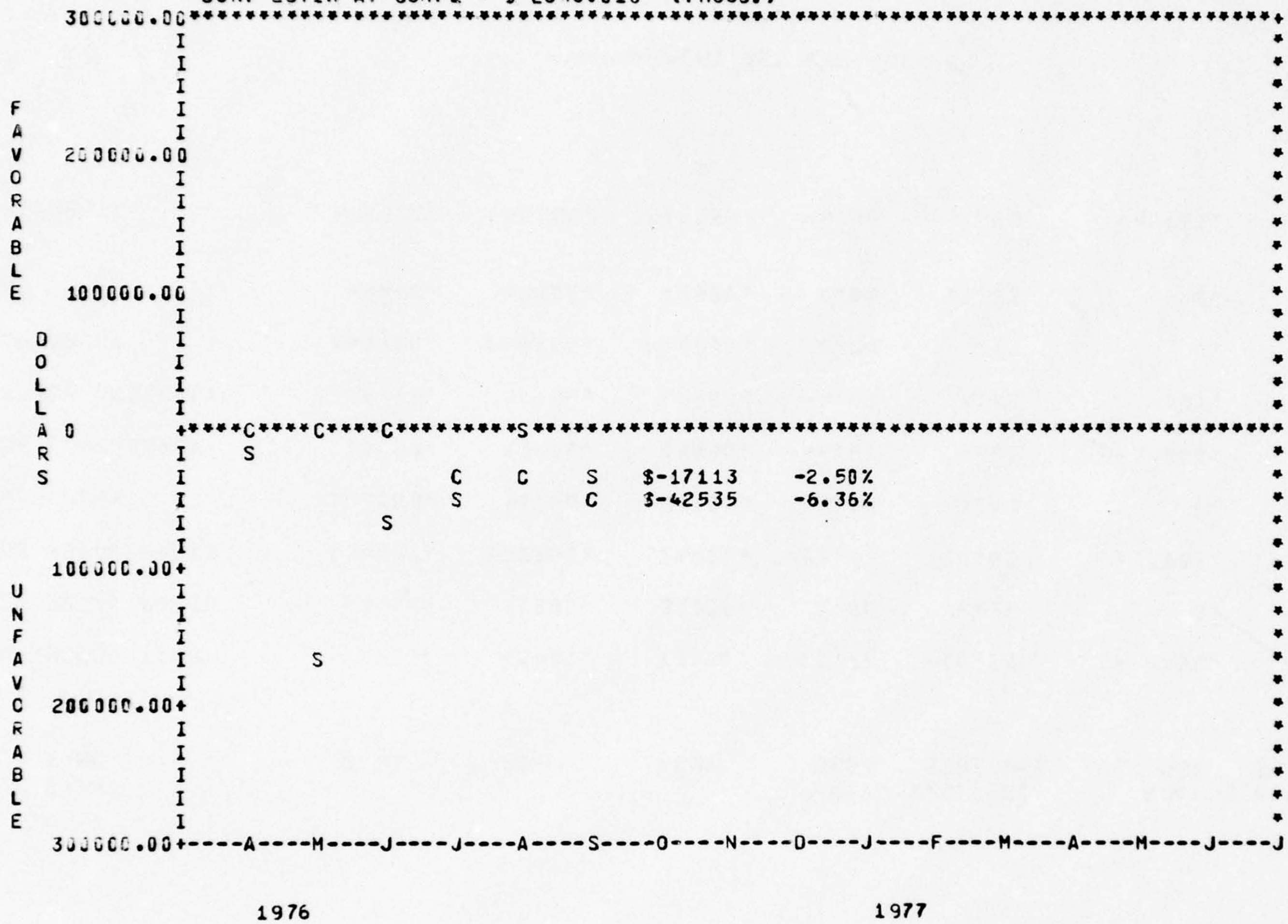
-1.00
3
6
9
12
15
18
21
24
MONTHS IN PROGRESS


1.00E+06
875000.00
750000.00
625000.00
500000.00
375000.00
250000.00
125000.00
0
COST - DOLLARS
0
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME - MONTHS
TOTAL PROGRAM
* BCWS
P BCWP
A ACWP

VARIANCE ANALYSIS FOR WHOSOMEEVER ED CONTRACT 76-C-0214 CART, XM185E1

ORIG CONTR TGT COST - $ 1281.591 (THOUS.)
CURR CONTR TGT COST - $ 2155.583 (THOUS.)
GOVT ESTIM AT COMPL - $ 2367.616 (THOUS.)
CONT ESTIM AT COMPL - $ 2346.018 (THOUS.)

C $ COST VARIANCE
S $ SCHEDULE VARIANCE



SCHEDULE VARIANCE IN WEEKS -.7

TABLE 1. CUMULATIVE DATA, PROGRAM WHOSOMEEVER ED CONTRACT 76-C-0214 CART, XM185E1 FOR 31 SEP 1977

ELEMENT NAME	BCWS	BCWP	ACWP	PCT. VARIANCE COST	PCT. VARIANCE SCHEDULE	DOLLAR VARIANCE COST	DOLLAR VARIANCE SCHEDULE
SYSTEM INTEGRATION	71713.	63400.	73400.	-15.77	-11.59	-10000.	-8313.
CARRIER METAL PARTS	81413.	81200.	81200.	0.00	-.26	0.	-213.
GRENADE METAL PARTS	114377.	102200.	124200.	-21.53	-10.65	-22000.	-12177.
FUZE ASSEMBLY	102106.	98600.	98600.	0.00	-3.43	0.	-3506.
GRENADE LOG+ASSBLY	15053.	15000.	25000.	-66.67	-.35	-10000.	-53.
PROJECTILE ASSEMBLY	10279.	12100.	12635.	-4.42	17.72	-535.	1821.
SELF DESTRUCT	245700.	246000.	246000.	0.00	.12	0.	300.
TOOLING	44872.	49900.	49900.	0.00	11.21	0.	5028.
ALL ELEMENTS	685513.	668400.	710935.	-6.36	-2.50	-42535.	-17113.

MANAGEMENT RESERVE DATA

CURRENT MONTH APPLICATION	$ 0
TOTAL APPLICATION TO DATE	$ 0
CURRENT MONTH BALANCE	$310347

TABLE 2. FLAGGED MONTHLY CUMULATIVE COST/SCHEDULE VARIANCES FOR PROGRAM WHOSOMEEVER ED CONTRACT 76-C-0214 CART, XM185E1 31 SEP 1977

ELEMENT NAME	COST VARIANCE PCT.	SCHEDULE VARIANCE PCT.	EAC/BUDGET VARIANCE PCT. CONTRACTOR	EAC/BUDGET VARIANCE PCT. GOVERNMENT
SYSTEM INTEGRATION	-15.77	-11.59	-1.42	-4.55
GRENADE METAL PARTS	-21.53	-10.65	.08	-2.44
GRENADE LDG+ASSBLY	-66.67	-.35	.03	-7.25
PROJECTILE ASSEMBLY	-4.42	17.72	.23	-1.22
TOOLING	0.00	11.21	.11	.00

TABLE 3. COST AT COMPLETION ESTIMATES FOR PROGRAM
WHOSOMEEVER ED CONTRACT 76-C-0214 CART, XM185E1   31 SEP 1977

ELEMENT NAME	TOTAL BUDGET	ESTIMATED COSTS AT COMPLETION AS DERIVED FROM						
		CONTRACTOR	COST VARIANCE	SCHEDULE VARIANCE	COST+SCHED. VARIANCES	TREND OF COST VAR.	AVERAGE OF VARIANCES	BAYESIAN
SYSTEM INTEGRATION	116113.	117764.	134427.	131338.	152053.	140434.	139563.	121392.
CARRIER METAL PARTS	95413.	95181.	95413.	95663.	95663.	106166.	98226.	95413.
GRENADE METAL PARTS	197377.	197216.	239865.	220894.	268445.	294892.	256024.	202195.
FUZE ASSEMBLY	151106.	151649.	151106.	156479.	156479.	163101.	156791.	151106.
GRENADE LOG+ASSBLY	37933.	37923.	63222.	38067.	63445.	53223.	54489.	40685.
PROJECTILE ASSEMBLY	21559.	21509.	22512.	18314.	19124.	26324.	21569.	21822.
SELF DESTRUCT	283500.	283834.	283500.	283154.	283154.	292952.	285690.	283500.
TOOLING	54232.	54175.	54232.	48768.	48768.	65085.	54213.	54232.
UNDISTRIBUTED BUDGET	0.	0.	0.	0.	0.	0.	0.	0.
GEN./ADMIN.	888003.	1076420.	1076420.	1076420.	1076420.	1076420.	1076420.	1076420.
TOTAL PROGRAM	1845236.	2035671.	2151078.	2080896.	2201328.	2302921.	2184056.	2057269.
MANAGEMENT RESERVE	310347.	310347.	310347.	310347.	310347.	310347.	310347.	310347.
GRAND TOTALS	2155583.	2346018.	2461425.	2391243.	2511675.	2613268.	2494403.	2367616.

ESTIMATES OF $0. REPRESENT PROGRAM ELEMENTS THAT HAVE LESS THAN 3 MOS. PROGRESS OR HAVE VARIANCES THAT ARE SO LARGE THAT THE EAC BECOMES MEANINGLESS (>400% OF THE ELEMENT BUDGET).

APPENDIX B

PROGRAM LISTING

```
      PROGRAM COST(INPUT,OUTPUT)
      COMMON/A/BCWS(20,20),BCWP(20,20),ACWP(20,20),EAC(20,20),KEY1,KEY2
      COMMON/B/LM(20),M(20),IFM(20),TCE(20,20),DA1,DA2,MA,MTU,MRC,WKS
      COMMON/C/SVD(20,20),SVP(20,20),CVD(20,20),CVP(20,20)
      COMMON/D/X(20),X1(20),YS(20),YA(20),YP(20)
      COMMON/E/NC,NP,NT,NOW,GTB,TB(20),HTN,IYR,IYR1,IYR2,UB,GA,GA1
      COMMON/F/FCCT(20,20),FCCV(20,20),FCSV(20,20),FCSC(20,20)
      COMMON/G/CPI(20,20),SPI(20,20),PLOTA(20,20),TREND(20,20),
     +OCTC,NAME(4,20),PLOTS(20,20),PLOTC(20,20)
      COMMON/H/BAY(20,20),CEAC(20,20),ECT
      COMMON/I/UE(20),PC(20),FACT(20),DUMMY(20)
      COMMON/J/CBCWS,CBCWP,CACWP,CCV,CSV,CGTB,CEST,KEY3
C
C KEY3 IS VARIABLE TO SIGNIFY EXISTENCE OF RELATED EFFORT DATA.
C IF RELATED EFFORT EXISTS SET KEY3=1. OTHERWISE, KEY3=0.
      READ 4,KEY3
4     FORMAT(I1)
C
      IF(KEY3.EQ.0)GOTO 18
C READ CONTRACTOR REPORT DATA FOR INCLUSION IN IN-HOUSE SUMMARY.
C FOR CONTRACTOR CS2 RUN THESE VALUES ARE 0 (ZERO).
      READ 16,CBCWS,CBCWP,CACWP,CCV,CSV,CGTB,CEST
16    FORMAT(7F10.0)
C
C READ ORIGINAL CONTRACT TARGET COST
18    READ 17,OCTC
17    FORMAT(F10.0)
C
C KEY TO PREVENT PRINT OF GRAPHS. SET KEY1=0 TO AVERT PERFORM-
C ANCE GRAPHS. SET KEY2=3 TO AVERT CS2 DATA GRAPHS.
      READ 15,KEY1,KEY2
15    FORMAT(2I5)
C
C INITIALIZE VARIABLES
      AV=CB=CC=CS=CT=0.
      DO 1 IX=1,20
      DO 1 IY=1,20
      BCWS(IX,IY)=BCWP(IX,IY)=ACWP(IX,IY)=EAC(IX,IY)=M(IX)=0.
      CPI(IX,IY)=SPI(IX,IY)=BAY(IX,IY)=CEAC(IX,IY)=TCE(IX,IY)=0.
1     FCCT(IX,IY)=FCCV(IX,IY)=FCSV(IX,IY)=FCSC(IX,IY)=GTB=0.
C
C READ DATE OF REPORT AND NO. OF WEEKS IN THE
C CURRENT + 2 PREVIOUS REPORT PERIODS.
      READ 2,DA1,DA2,WKS
2     FORMAT(2A10,F5.0)
C
C READ NUMBER OF PROGRAM ELEMENTS AS OF ABOVE DATE
      READ 3,NK
3     FORMAT(I3)
C
C READ 1ST MONTH AND YEAR OF PROGRAM (EX. JANUARY  1975)
      READ 12,HTN,IYR
12    FORMAT(A10,I4)
```

```
      IYR1=IYR+1
      IYR2=IYR+2
C
C SET VARIABLE AND NAME FOR TOTAL PROGRAM
      NT=NK+1
      NAME(1,NT)=10H TOTAL PRO
      NAME(2,NT)=4HGRAM
C
C READ PROGRAM NAME (TO 40 CHARACTERS)
      READ 6,(NAME(IQ,NT+1),IQ=1,5)
6     FORMAT(5A10)
C
C READ UNDISTRIBUTED BUDGET, G AND A.
      READ 14,UB,GA,GA1
14    FORMAT(3F10.0)
C
C READ ORIGINAL, PREVIOUS AND CURRENT MONTH MANAGEMENT
C RESERVE BALANCES.
      READ 13,MRO,MRP,MRC
13    FORMAT(3I10)
      MA=MRP-MRC
      MTU=MRO-MRC
C
C LOOP OVER EACH PROGRAM ELEMENT
      DO 7 NP=1,NK
C
C INITIALIZE GRAPH VARIABLES
      IC=0
      DO 11 IX=1,20
      X(IX)=0.
      YA(IX)=0.
      YP(IX)=0.
11    YS(IX)=0.
C
C READ THE NAME OF PROGRAM ELEMENT (20 CHARACTERS MAX.)
      READ 5,NAME(1,NP),NAME(2,NP)
5     FORMAT(2A10)
C
C READ MONTHS IN PROGRESS, 1ST MONTH,LAST MONTH,BUDGET
      READ 8,M(NP),IFM(NP),LM(NP),TB(NP)
8     FORMAT(3I5,F10.0)
C
C SET ELEMENT VARIABLES
      MONTH=M(NP)
      NOW=IFM(NP)+M(NP)-1
      IFIRST=IFM(NP)
      LAST=LM(NP)
      GTB=GTB+TB(NP)
C
C LOOP OVER EACH MONTH FOR ELEMENT NP
      DO 9 M1=IFIRST,LAST
      IC=IC+1
C
```

```
C READ COST DATA
      READ 10,BCWS(NP,M1),BCWP(NP,M1),ACWP(NP,M1),CEAC(NP,M1)
10    FORMAT(4F8.0)
C
C SET PLOT POINTS AND COMPUTE TOTAL CONTRACTOR ESTIMATE
      X(IC)=FLOAT(IC)
      YS(IC)=BCWS(NP,M1)
C
C SKIP TO NEXT MONTH IF BEYOND CURRENT MONTH
      IF(M1.GT.NOW)GOTO 9
C
C COMPUTE $/% COST AND SCHEDULE VARIANCES.
      SVD(NP,M1)=BCWP(NP,M 1)-BCWS(NP,M1)
      SVP(NP,M1)=SVD(NP,M1)/BCWS(NP,M1)
      CVD(NP,M1)=BCWP(NP,M1)-ACWP(NP,M1)
      CVP(NP,M1)=CVD(NP,M1)/BCWP(NP,M1)
C
C SET INDEXES
      CALL INDEX(M1,IFIRST,LAST,IC)
C
C COMPUTE FINAL COST ESTIMATES EVERY MONTH
      CALL FINAL(M1,IFIRST,AV,CB,CC,CS,CT)
C
C SET FINAL ESTIM. VARIABLES EACH MONTH
      FCCT(NP,M1)=CT
      FCCV(NP,M1)=CC
      FCSV(NP,M1)=CS
      FCSC(NP,M1)=CB
      EAC(NP,M1)=AV
C
C SET PLOT POINTS FOR COSTS GRAPH
      YP(IC)=BCWP(NP,M1)
      YA(IC)=ACWP(NP,M1)
      NC=IC
      X1(IC)=FLOAT(IC)
C
C LOOP BACK TO NEXT MONTHS DATA
9     CONTINUE
C
C DRAW COSTS GRAPH FOR THIS ELEMENT
      CALL GRAPH(IC)
C
C LOOP BACK TO NEXT PROGRAM ELEMENT.
7     CONTINUE
C
C COMPUTE TOTAL PROGRAM VALUES.
      CALL ALLEL(NK,SVW)
C
C COMPUTE BAYESIAN ESTIMATE FOR ALL ELEMENTS AND TOTAL PROGRAM.
      CALL BAYES
C
C COMPUTE AND GRAPH VARIANCE TRENDS
      CALL TRENDS(SVW)
C
C PRINT TABULAR DATA
      CALL TABLES
C
      END
```

```
OUTINE ALLEL(NK,SVW)
ON/A/BCWS(20,20),BCWP(20,20),ACWP(20,20),EAC(20,20),KEY1,KEY2
ON/B/LM(20),M(20),IFM(20),TCE(20,20),DA1,DA2,MA,MTU,MRC,WKS
ON/C/SVD(20,20),SVP(20,20),CVD(20,20),CVP(20,20)
ON/D/X(20),X1(20),YS(20),YA(20),YP(20)
ON/E/NC,NP,NT,NOW,GTB,TB(20),HTN,IYR,IYR1,IYR2,UB,GA,GA1
ION/F/FCCT(20,20),FCCV(20,20),FCSV(20,20),FCSC(20,20)
ION/G/CPI(20,20),SPI(20,20),PLOTA(20,20),TREND(20,20),
,NAME(4,20),PLOTS(20,20),PLOTC(20,20)
ION/H/BAY(20,20),CEAC(20,20),ECT

GTB+UB+GA

IGEST ELEMENT AND OLDEST ELEMENT
=LM(1)
=M(1)
 IX=2,NK
(IX).LE.JBIG)GOTO 4
=M(IX)
M(IX).LE.IBIG)GOTO 1
=LM(IX)
TINUE

 OF PLOT POINTS
T)=JBIG
NT)=IBIG
THLY COST ELEMENTS
2 IY=1,IBIG
IC+1
C)=FLOAT(IC)
3 IX=1,NK
IY.LE.LM(IX))GOTO 5
S(IX,IY)=BCWS(IX,LM(IX))
P(IX,IY)=BCWP(IX,LM(IX))
P(IX,IY)=ACWP(IX,LM(IX))
C(IX,IY)=ACWP(IX,LM(IX))
S(NT,IY)=BCWS(NT,IY)+BCWS(IX,IY)
P(NT,IY)=BCWP(NT,IY)+BCWP(IX,IY)
P(NT,IY)=ACWP(NT,IY)+ACWP(IX,IY)
(NT,IY)=TCE(NT,IY)+CEAC(IX,IY)
TINUE

T POINTS FOR COST GRAPH
IC)=BCWS(NT,IY)

 NEXT MONTH IF BEYOND CURRENT MONTH.
IY.GT.NOW)GOTO 2

T POINTS FOR COST GRAPH
IC)=BCWP(NT,IY)
IC)=ACWP(NT,IY)

IC)=FLOAT(IC)
```

```
C
C COMPUTE DOLLAR AND % COST/SCHEDULE VARIANCES
      SVD(NT,IY)=BCWP(NT,IY)-BCWS(NT,IY)
      SVP(NT,IY)=SVD(NT,IY)/BCWS(NT,IY)
      CVD(NT,IY)=BCWP(NT,IY)-ACWP(NT,IY)
      CVP(NT,IY)=CVD(NT,IY)/BCWP(NT,IY)
C
C SET NP INDEX FOR TOTAL PROGRAM
      NP=NT
      TB(NT)=GTB
C
C COMPUTE INDEXES.
      CALL INDEX(IY,1,IBIG,IC)
C COMPUTE FINAL COST ESTIMATES
      CALL FINAL(IY,1,AV,CB,CC,CS,CT)
      FCCT(NT,IY)=CT
      FCCV(NT,IY)=CC
      FCSV(NT,IY)=CS
      FCSC(NT,IY)=CB
      EAC(NT,IY)=AV
C
2     CONTINUE
      CALL GRAPH(IC)
C
C COMPUTE SCHEDULE VARIANCE IN WEEKS
      VPW=(BCWP(NT,NOW)-BCWP(NT,NOW-3))/WKS
      SVW=(BCWP(NT,NOW)-BCWS(NT,NOW))/VPW
      RETURN
      END
```

```
      SUBROUTINE BAYES
      COMMON/A/S(20,20),P(20,20),A(20,20),E(20,20),KEY1,KEY2
      COMMON/B/L(20),M(20),I(20),TCE(20,20),DA1,DA2,MA,MTU,MRC,WKS
      COMMON/E/NC,NP,NT,NOW,GTB,TB(20),HTN,IYR,IYR1,IYR2,UB,GA,GA1
      COMMON/F/FCCT(20,20),FCCV(20,20),FCSV(20,20),FCSC(20,20)
      COMMON/G/CPI(20,20),SPI(20,20),PLOTA(20,20),TREND(20,20),
     +OCTC,NAME(4,20),PLOTS(20,20),PLOTC(20,20)
      COMMON/H/BAY(20,20),CEAC(20,20),ECT
      DIMENSION F(20,20)
C
C INITIALIZE VARAIBLE FRACO,FRACA
      FRACO=FRACA=0.
C
C SET INDEX FOR LAST 3 MOS.
      IZ=NOW-2
C LOOP OVER EACH ELEMENT AND THE TOTAL PROGRAM
      DO 1 IX=1,NT
C IF ELEMENT IS NOT 3 MOS. OLD SKIP TO NEXT ELEMENT
      IF(M(IX).LE.2)GOTO 1
C INITIALIZE SUMS
      SUM1=SUM2=0.
C LOOP OVER LAST 3 MOS.
      DO 2 IY=IZ,NOW
      IF(IX.NE.NT)GOTO 5
      TCE(IX,IY)=TCE(IX,IY)+UB+GA
      IF(TCE(IX,IY).EQ.UB+GA)TCE(IX,IY)=0.
      CEAC(IX,IY)=TCE(IX,IY)
C IF CONTRACTOR DOES NOT SUPPLY EAC-USE AVERAGE VALUE FROM FINAL
5     F(IX,IY)=CEAC(IX,IY)
      IF(CEAC(IX,IY).EQ.FCCV(IX,IY).OR.CEAC(IX,IY).EQ.FCSV(IX,IY).OR.
     +CEAC(IX,IY).EQ.0.)F(IX,IY)=E(IX,IY)
C BAYES COMPUTATIONS START
      SUM1=SUM1+ABS(PLOTC(IX,IY))**2.
2     SUM2=SUM2+ABS(((TB(IX)-F(IX,IY))/TB(IX)))**2.
      IF(SUM1.LE.0.)GOTO 3
      FRACA=SQRT(SUM1/3.)
3     IF(SUM2.LE.0.)GOTO 4
      FRACO=SQRT(SUM2/3.)
C LIMIT ESTIMATE IN 1ST 3 MOS. TO 5% OF BUDGET
4     IF(M(IX).EQ.3.AND.FRACO.LT..05)FRACO=.05
      CSQ=(TB(IX)/P(IX,NOW))**2.
      SIGA2=(FRACA*A(IX,NOW))**2.
      SIGO2=(FRACO*TB(IX))**2.
C BAYESIAN FINAL ESTIMATED COST  NOW COMPUTED
      BAY(IX,NOW)=((SQRT(CSQ)*A(IX,NOW)*SIGO2)+
     +(TB(IX)*CSQ*SIGA2))/(SIGO2+CSQ*SIGA2)
C LOOP TO NEXT ELEMENT
1     CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FINAL(I,J,AV,CB,CC,CS,CT)
      COMMON/E/NC,NP,NT,NOW,GTB,TB(20),HTN,IYR,IYR1,IYR2,UB,GA,GA1
      COMMON/G/CPI(20,20),SPI(20,20),PLOTA(20,20),TREND(20,20),
     +OCTC,NAME(4,20),PLOTS(20,20),PLOTC(20,20)
C
      IF(NP.EQ.NT)TB(NP)=GTB
C INITIALIZE VARIABLES
      KEY=CB=CC=CS=CT=0.
C
C SET KEY IF AVER. EST DEPENDS ON 4 VALUES.
      IF(I-J.GE.2)KEY=1
      IF(KEY.EQ.0)GOTO 7
C
C COMPUTE COST TREND IF ELEMENT IS OLDER THAN 2 MOS.
      CT=TB(NP)/TREND(NP,I)
C
C COMPUTE OTHER FINAL ESTIMATES
7     CC=TB(NP)/CPI(NP,I)
      CS=TB(NP)/SPI(NP,I)
      CB=TB(NP)/(SPI(NP,I)*CPI(NP,I))
C
C COMPUTE AVERAGE OF ESTIMATES
      IF(KEY.EQ.0)AV=(CB+CC+CS)/3.
      IF(KEY.EQ.1)AV=(CB+CC+CS+CT)/4.
      RETURN
      END
```

```
      SUBROUTINE GRAPH(IC)
      COMMON/A/S(20,20),P(20,20),A(20,20),E(20,20),KEY1,KEY2
      COMMON/B/LM(20),M(20),IFM(20),TCE(20,20),DA1,DA2,MA,MTU,MRC,WKS
      COMMON/D/X(20),X1(20),YS(20),YA(20),YP(20)
      COMMON/E/NC,NP,NT,NOW,GTB,DUM4(27)
      COMMON/G/DUM(1600),OCTC,NAME(4,20),DUM5(800)
      IF(KEY2.EQ.0)RETURN
      BIG=S(NP,LM(NP))
      IF(P(NP,NOW).GT.BIG)BIG=P(NP,NOW)
      IF(A(NP,NOW).GT.BIG)BIG=A(NP,NOW)
      IF(BIG.LE.100)IG=IFIX(BIG/10.)*10+10
      IF(BIG.GT.100..AND.BIG.LE.1000.)IG=IFIX(BIG/100.)*100+100
      IF(BIG.GT.1000..AND.BIG.LE.10000.)IG=IFIX(BIG/1000.)*1000+1000
      IF(BIG.GT.10000..AND.BIG.LE.100000.)
     +IG=IFIX(BIG/10000.)*10000+10000
      IF(BIG.GT.100000..AND.BIG.LE.1000000.)
     +IG=IFIX(BIG/100000.)*100000+100000
      IF(BIG.GT.1000000..AND.BIG.LE.10000000.)
     +IG=IFIX(BIG/1000000.)*1000000+1000000
      DY=FLOAT(IG)
      DX=0.
      IF(IC/8*8.EQ.IC)GOTO 13
      IM=IC+4
      IF(IM/8*8.EQ.IM)GOTO 14
      IF(IM.LT.8)DX=8.
      IF(IM.GT.8.AND.IM.LT.16)DX=16.
      IF(IM.GT.16.AND.IM.LT.24)DX=24.
      IF(IM.GT.24.AND.IM.LT.32)DX=32.
      GOTO 15
14    DX=FLOAT(IM)
      GOTO 15
13    DX=FLOAT(IC)
15    DY=DY/8.
      DX=DX/8.
      CALL PLOT(2.,1.5,-43)
      CALL SCALE(X,IC,1,8.,0.,DX,1)
      CALL SCALE(X1,NC,1,8.,0.,DX,1)
      CALL SCALE(YS,IC,1,8.,0.,DY,1)
      CALL SCALE(YP,NC,1,8.,0.,DY,1)
      CALL SCALE(YA,NC,1,8.,0.,DY,1)
      CALL AXIS(0.,0.,15HTIME  -  MONTHS,15,8.,0.,0.,DX)
      CALL AXIS(0.,0.,16HCOST  -  DOLLARS,16,8.,90.,0.,DY)
      CALL LINE(X,YS,IC,1,54,.07,1)
      CALL LINE(X1,YP,NC,1,47,.07,1)
      CALL LINE(X1,YA,NC,1,21,.07,1)
      CALL SYMBOL(8.,8.,1H+,1,.07,0.)
      CALL SYMBOL(8.5,3.,7H*  BCWS,7,.07,0.)
      CALL SYMBOL(8.5,2.9,7HP  BCWP,7,.07,0.)
      CALL SYMBOL(8.5,2.8,7HA  ACWP,7,.07,0.)
      CALL SYMBOL(8.25,3.25,NAME(1,NP),10,.07,0.)
      CALL SYMBOL(9.25,3.25,NAME(2,NP),10,.07,0.)
      CALL PLOT(8.,0.,3)
      CALL PLOT(8.,8.,2)
      CALL PLOT(0.,8.,2)
      CALL PLOT(0.,0.,-3)
      RETURN
      END
```

```
      SUBROUTINE INDEX(I,J,K,IC)
      COMMON/A/S(20,20),P(20,20),A(20,20),E(20,20),KEY1,KEY2
      COMMON/B/LM(20),M(20),IFM(20),TCE(20,20),DA1,DA2,MA,MTU,MRC,WKS
      COMMON/E/NC,NP,NT,NOW,GTB,TB(20),HTN,IYR,IYR1,IYR2,UB,GA,GA1
      COMMON/G/CPI(20,20),SPI(20,20),PLOTA(20,20),TREND(20,20),
     +OCTC,NAME(4,20),PLOTS(20,20),PLOTC(20,20)
      DIMENSION W(20,20),Y(20),X(20),
     +YC(20),YS(20),X1(20),XZ(2),YZ(2)
C
C INITIALIZE X VALUES.
      IF(I.NE.J)GOTO 8
      ID=0
      DO 9 IX=1,20
      Y(IX)=0.
9     X(IX)=0.
C
C ELEMENTS SHORTER THAN 7 MOS. TOTAL OR OLDER
C THAN 4 MONTHS DURATION WILL NOT HAVE ADJUSTED INDEXES.
8     IF(K-J+1.LE.6)GOTO 1
      IF(I-J.GE.4)GOTO 1
C
C LOOP TO SET BCWS OR BCWP TO NEW VARIABLE (W)
      DO 2 IX=1,2
      IF(P(NP,I).EQ.0.)GOTO 2
      W(NP,I)=S(NP,I)
      IF(IX.EQ.2)W(NP,I)=A(NP,I)
      IF(I.EQ.J)PP=.3*W(NP,I)+.7*P(NP,I)
      IF(I.EQ.J+1)PP=.1*W(NP,I)+.9*P(NP,I)
      IF(I.EQ.J+2)PP=.05*W(NP,I)+.95*P(NP,I)
      IF(PP.EQ.0.)GOTO 2
C
C COMPUTE SPI, CPI AND SET PLOT POINTS FOR GRAPH (1ST 4 MOS.)
      GOTO(3,4)IX
3     SPI(NP,I)=PP/W(NP,I)
      PLOTS(NP,I)=(PP-W(NP,I))/PP
      YS(IC)=PLOTS(NP,I)
      GOTO 2
4     CPI(NP,I)=PP/W(NP,I)
      PLOTC(NP,I)=(PP-W(NP,I))/PP
      YC(IC)=PLOTC(NP,I)
C
C LOOP BACK TO IX=2
2     CONTINUE
C
C COMPUTE 3 MO. CPI TREND AND SET PLOT POINTS (1ST 4 MOS.)
      IF(I-J.LT.2)GOTO 5
      ID=ID+1
      PLOTA(NP,I)=(PLOTC(NP,I-2)+PLOTC(NP,I-1)+PLOTC(NP,I))/3.
      TREND(NP,I)=(CPI(NP,I-2)+CPI(NP,I-1)+CPI(NP,I))/3.
      Y(ID)=PLOTA(NP,I)
      X(ID)=FLOAT(IC)
5     X1(IC)=FLOAT(IC)
      GOTO 6
```

```
C
C COMPUTE INDEXES AND SET FLOT POINTS FOR GRAPH (STARTING 5TH MO.)
1      SPI(NP,I)=P(NP,I)/S(NP,I)
       PLOTS(NP,I)=(P(NP,I)-S(NP,I))/P(NP,I)
       YS(IC)=PLOTS(NP,I)
       CPI(NP,I)=P(NP,I)/A(NP,I)
       PLOTC(NP,I)=(P(NP,I)-A(NP,I))/P(NP,I)
       YC(IC)=PLOTC(NP,I)
       PLOTA(NP,I)=(PLOTC(NP,I-2)+PLOTC(NP,I-1)+PLOTC(NP,I))/3.
       TREND(NP,I)=(CPI(NP,I-2)+CPI(NP,I-1)+CPI(NP,I))/3.
       ID=ID+1
       Y(ID)=PLOTA(NP,I)
       X(ID)=FLOAT(IC)
       X1(IC)=FLOAT(IC)
C
C PLOT GRAPHS WHEN NOW MONTH IS REACHED
6      IF(I.NE.NOW)RETURN
       IF(KEY1.EQ.0)RETURN
       XZ(1)=YZ(1)=YZ(2)=0.
       XZ(2)=24.
       PRINT 14,NAME(1,NP),NAME(2,NP)
14     FORMAT(1H1,////////////////////////////////////33X,
      +*THE FOLLOWING GRAPHS RELATE TO PROGRAM ELEMENT   *,2A10)
       DO 12 IX=1,3
       CALL PLOT(2.,2.5,-43)
       IF(IX.GT.1)GOTO 13
       CALL SCALE(X,IC,1,8.,0.,3.,1)
       CALL SCALE(X1,IC,1,8.,0.,3.,1)
       CALL SCALE(XZ,2,1,8.,0.,3.,1)
       CALL SCALE(YZ,2,1,4.,-1.,0.5,1)
       CALL SCALE(Y,ID,1,4.,-1.,0.5,1)
       CALL SCALE(YS,IC,1,4.,-1.,0.5,1)
       CALL SCALE(YC,IC,1,4.,-1.,0.5,1)
13     CALL LINE(XZ,YZ,2,1,20,.07,0)
       CALL AXIS(0.,0.,0.,0,4.,90.,-1.,.5)
       CALL SYMBOL(1.,0.,1H3,1,.07,0.)
       CALL SYMBOL(2.,0.,1H6,1,.07,0.)
       CALL SYMBOL(3.,0.,1H9,1,.07,0.)
       CALL SYMBOL(4.,0.,2H12,2,.07,0.)
       CALL SYMBOL(5.,0.,2H15,2,.07,0.)
       CALL SYMBOL(6.,0.,2H18,2,.07,0.)
       CALL SYMBOL(7.,0.,2H21,2,.07,0.)
       CALL SYMBOL(8.,0.,2H24,2,.07,0.)
       CALL SYMBOL(-1.25,2.7,9HFAVORABLE,9,.07,90.)
       CALL SYMBOL(-1.25,.1,11HUNFAVORABLE,11,.07,90.)
       CALL SYMBOL(3.,-.4,18HMONTHS IN PROGRESS,18,.07,0.)
       GOTO(10,11,7)IX
7      CALL LINE(X,Y,ID,1,20,.07,1)
       CALL SYMBOL(6.,4.1,22H3 MONTH MOVING AVERAGE,22,.07,0.)
       CALL SYMBOL(6.,3.9,22HCOST PERFORMANCE INDEX,22,.07,0.)
       CALL SYMBOL(6.,3.3,NAME(1,NP),10,.07,0.)
       CALL SYMBOL(7.,3.3,NAME(2,NP),10,.07,0.)
       CALL PLOT(0.,0.,-3)
```

```
      GOTO 12
10    CALL LINE(X1,YS,IC,1,20,.07,1)
      CALL SYMBOL(5.4,4.0,26HSCHEDULE PERFORMANCE INDEX,26,.07,0.)
      CALL SYMBOL(6.,3.8,NAME(1,NP),10,.07,0.)
      CALL SYMBOL(7.,3.8,NAME(2,NP),10,.07,0.)
      CALL PLOT(0.,0.,-3)
      GOTO 12
11    CALL LINE(X1,YC,IC,1,20,.07,1)
      CALL SYMBOL(6.,4.0,22HCOST PERFORMANCE INDEX,22,.07,0.)
      CALL SYMBOL(6.,3.8,NAME(1,NP),10,.07,0.)
      CALL SYMBOL(7.,3.8,NAME(2,NP),10,.07,0.)
      CALL PLOT(0.,0.,-3)
12    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE TABLES
      COMMON/A/BCWS(20,20),BCWP(20,20),ACWP(20,20),EAC(20,20),KEY1,KEY2
      COMMON/B/LM(20),M(20),IFM(20),TCE(20,20),DA1,DA2,MA,MTU,MRC,WKS
      COMMON/C/SVD(20,20),SVP(20,20),CVD(20,20),CVP(20,20)
      COMMON/E/NC,NP,NT,NOW,GTB,TB(20),HTN,IYR,IYR1,IYR2,UB,GA,GA1
      COMMON/F/FCCT(20,20),FCCV(20,20),FCSV(20,20),FCSC(20,20)
      COMMON/G/DUM20(1600),OCTC,NAME(4,20),DUM30(800)
      COMMON/H/BAY(20,20),CEAC(20,20),ECT
      COMMON/J/CBCWS,CBCWP,CACWP,CCV,CSV,CGTB,CEST,KEY3
      DIMENSION N1(20),CPCT(20),GPCT(20)
C PRINT TABLES OF INFORMATION.
      PRINT 50,(NAME(IQ,NT+1),IQ=1,5),DA1,DA2
50    FORMAT(1H1,////24X,*TABLE 1.  CUMULATIVE DATA, PROGRAM *,
     +4A10,/34X,A10,* FOR *,2A10//////17X,*ELEMENT*,45X,*PCT. *,
     +*VARIANCE*,7X,*DOLLAR VARIANCE*/19X,*NAME*,15X,*BCWS*,
     +6X,*BCWP*,6X,*ACWP*,6X,*COST   SCHEDULE*,6X,
     +*COST   SCHEDULE*///)
      IF(KEY3.EQ.0)GOTO 40
      CWS=CBCWS+BCWS(NT,NOW)
      CWP=CBCWP+BCWP(NT,NOW)
      CAW=CACWP+ACWP(NT,NOW)
      CV=CCV+CVD(NT,NOW)
      SV=CSV+SVD(NT,NOW)
      CE=CEST+TCE(NT,NOW)
40    DO 51 N=1,NP
      CVP(N,NOW)=CVP(N,NOW)*100.
      SVP(N,NOW)=SVP(N,NOW)*100.
      IF(N.EQ.NP)GOTO 51
      PRINT 52,NAME(1,N),NAME(2,N),BCWS(N,NOW),BCWP(N,NOW),ACWP(N,NOW),
     +CVP(N,NOW),SVP(N,NOW),CVD(N,NOW),SVD(N,NOW)
52    FORMAT(11X,2A10,3X,3F10.0,F8.2,F9.2,F13.0,F10.0/)
51    CONTINUE
      PRINT 3,BCWS(NT,NOW),BCWP(NT,NOW),
     +ACWP(NT,NOW),CVP(NT,NOW),SVP(NT,NOW),
     +CVD(NT,NOW),SVD(NT,NOW)
3     FORMAT(/12X,*ALL ELEMENTS*,10X,3F10.0,F8.2,F9.2,F13.0,F10.0)
      IF(KEY3.EQ.0)GOTO 41
      PRINT 42,CBCWS,CBCWP,CACWP,CCV,CSV,
     +CWS,CWP,CAW,CV,SV
42    FORMAT(11X,*CONTRACTOR EFFORT*,6X,3F10.0,20X,2F10.0,/
     +11X,*COMBINED TOTAL*,9X,3F10.0,20X,2F10.0)
41    PRINT 8,MA,MTU,MRC
8     FORMAT(/////52X,*MANAGEMENT RESERVE DATA*,///44X,
     +*CURRENT MONTH APPLICATION*,10X,*$*,I6//44X,*TOTAL*,
     +* APPLICATION TO DATE*,10X,*$*,I6//44X,*CURRENT*,
     +* MONTH BALANCE*,14X,*$*,I6)
      IFLAG=0
      DO 60 N=1,NT
      IF(CEAC(N,NOW).NE.0.)GOTO 1
      CPCT(N)=0.
      GOTO 2
1     CPCT(N)=(TB(N)-CEAC(N,NOW))/TB(N)*100.
2     GPCT(N)=(TB(N)-BAY(N,NOW))/TB(N)*100.
```

```
      IF(GPC (N).EQ.100..AND.NOW.LE.2)GPCT(N)=0.
      IF(CVP N,NOW).LT.10..AND.CVP(N,NOW).GT.-10..AND.
     +SVP(N,NOW).LT.10..AND.SVP(N,NOW).GT.-10..AND.CPCT(N)
     +.LT.10..AND.CPCT(N).GT.-10..AND.GPCT(N).LT.10.
     +.AND.GPCT(N).GT.-10.)GOTO 60
      IFLAG=IFLAG+1
      N1(IFLAG)=N
60    CONTINUE
      IF(IFLAG.EQ.0)GOTO 64
      PRINT 61,(NAME(IQ,NT+1),IQ=1,5),DA1,DA2
61    FORMAT(1H1,/////19X,*TABLE 2.  FLAGGED MONTHLY *,
     +*CUMULATIVE COST/SCHEDULE VARIANCES FOR PROGRAM*/
     +29X,5A10,3X,2A10,///////41X,*COST*,12X,*SCHEDULE*,
     +11X,*EAC/BUDGET VARIANCE PCT.*/12X,*ELEMENT NAME*,13X,
     +*VARIANCE PCT.*,5X,*VARIANCE PCT.*,8X,*CONTRACTOR     *,
     +*GOVERNMENT*///)
      DO 62 N=1,IFLAG
      IF(N1(N).NE.NT)GOTO 5
      PRINT 66,NAME(1,NT),NAME(2,NT),CVP(NT,NOW),SVP(NT,NOW),
     +CPCT(NT),GPCT(NT)
66    FORMAT(/9X,2A10,F16.2,F18.2,F20.2,F14.2)
      GOTO 62
5     PRINT 63,NAME(1,N1(N)),NAME(2,N1(N)),CVP(N1(N),NOW),
     +SVP(N1(N),NOW),CPCT(N1(N)),GPCT(N1(N))
63    FORMAT(/9X,2A10,F16.2,F18.2,F20.2,F14.2)
62    CONTINUE
      GOTO 70
64    PRINT 61,(NAME(IQ,NT+1),IQ=1,5),DA1,DA2
      PRINT 65
65    FORMAT(////////////////39X,*NO VARIANCES ARE *,
     +*GREATER THAN +10 PCT. OR -10 PCT.*)
70    PRINT 71,(NAME(IQ,NT+1),IQ=1,5),DA1,DA2
71    FORMAT(1H1,///35X,*TABLE 3.  COST AT COMPLETION*,
     +* ESTIMATES FOR PROGRAM*/45X,5A10,3X,2A10///////
     +64X,*ESTIMATED COSTS AT COMPLETION AS DERIVED *,
     +*FROM */37X,90(1H*)/4X,*ELEMENT*,16X,*TOTAL*,
     +22X,*COST*,7X,*SCHEDULE*,3X,*COST+SCHED.*,
     +3X,*TREND OF*,5X,*AVERAGE OF*/
     +6X,*NAME*,17X,*BUDGET*,4X,*CONTRACTOR*,2(5X,
     +*VARIANCE*),4X,*VARIANCES*,4X,*COST VAR.*,4X,
     +*VARIANCES*,4X,*BAYESIAN*///)
      DO 72 N=1,NP
      IF(N.EQ.NP)GOTO 72
      IF(FCCV(N,NOW).GE.5.*TB(N))FCCV(N,NOW)=0.
      IF(FCSV(N,NOW).GE.5.*TB(N))FCSV(N,NOW)=0.
      IF(FCSC(N,NOW).GE.5.*TB(N))FCSC(N,NOW)=0.
      IF(FCCT(N,NOW).GE.5.*TB(N))FCSC(N,NOW)=0.
      IF(EAC(N,NOW).GE.5.*TB(N))EAC(N,NOW)=0.
      PRINT 73,NAME(1,N),NAME(2,N),TB(N),CEAC(N,NOW),FCCV(N,NOW),
     +FCSV(N,NOW),FCSC(N,NOW),FCCT(N,NOW),EAC(N,NOW),
     +BAY(N,NOW)
73    FORMAT(3X,2A10,F10.0,7F13.0,/)
72    CONTINUE
```

```
      PRINT 76,UB,UB,U ,UB,UB,UB,UB,UB,GA,GA1,GA1,GA1,GA1,GA1,GA1,GA1
76    FORMAT(3X,*UNDIS RIBUTED BUDGET*,F10.0,7(F13.0),/3X,
     +*GEN./ADMIN.*,F1 .0,7(F13.0))
      XMRC=FLOAT(MRC)
      IF(NOW.LE.2)TCE( T,NOW)=TCE(NT,NOW)+UB+GA
      TCE(NT,NOW)=TCE( T,NOW)+GA1-GA
      FCCV(NT,NOW)=FCC (NT,NOW)+GA1-GA
      FCSV(NT,NOW)=FCS (NT,NOW)+GA1-GA
      FCSC(NT,NOW)=FCS (NT,NOW)+GA1-GA
      FCCT(NT,NOW)=FCC (NT,NOW)+GA1-GA
      EAC(NT,NOW)=EAC( T,NOW)+GA1-GA
      BAY(NT,NOW)=BAY( T,NOW)+GA1-GA
      PRINT 7,NAME(1,N ),NAME(2,NT),GTB,TCE(NT,NOW),FCCV(NT,NOW),
     +FCSV(NT,NOW),FCS (NT,NOW),FCCT(NT,NOW),EAC(NT,NOW),
     +BAY(NT,NOW)
7     FORMAT(/3X,2A10, 10.0,7F13.0)
      TCV=FCCV(NT,NOW) XMRC
      TSV=FCSV(NT,NOW) XMRC
      TSC=FCSC(NT,NOW) XMRC
      TCT=FCCT(NT,NOW) XMRC
      TAV=EAC(NT,NOW)+ MRC
      ECT=TCE(NT,NOW)+ MRC
      IF(TCE(NT,NOW).E( .0.)ECT=0.
      GTB=GTB+XMRC
      TBAY=BAY(NT,NOW) XMRC
      IF(NOW.LE.2)TBAY=0.
      XMRC5=XMRC
      IF(NOW.LE.2)XMRC =0.
      TBUD=CGTB+GTB
      PRINT 74,XMRC,XMRC,XMRC,XMRC,XMRC,XMRC,XMRC,XMRC5
74    FORMAT(4X,*MANAGE ENT RESERVE*,F11.0,7F13.0)
      PRINT 75,GTB,ECT, CV,TSV,TSC,TCT,TAV,TBAY
75    FORMAT(4X,*GRAND OTALS*,4X,8F13.0)
      IF(KEY3.EQ.0)GOTO 43
      PRINT 44,CGTB,CES ,TBUD,CE
44    FORMAT(/5X,*CONTR CTOR EFFORT*,F11.0,F13.0/
     +5X,*COMBINED TOTA *,F14.0,F13.0)
43    PRINT 10
10    FORMAT(/////35X,* STIMATES OF $0. REPRESENT PROGRAM ELEMENTS*,
     +* THAT HAVE LESS HAN 3 MOS.*/35X,*PROGRESS OR HAVE VARIANCES*,
     +* THAT ARE SO LARGE THAT THE EAC BECOMES*/
     +35X,*MEANINGLESS (>400% OF THE ELEMENT BUDGET).*)
      RETURN
      END
```

```
      SUBROUT:NE TRENDS(SVW)
      COMMON/ /LM(20),M(20),IFM(20),TCE(20,20),DA1,DA2,MA,MTU,MRC,WKS
      COMMON/( /SVD(20,20), SVP(20,20),CVD(20,20),CVP(20,20)
      COMMON/E /NC,NP,NT,NOW,GTB,TB(20),HTN,IYR,IYR1,IYR2,UB,GA,GA1
      COMMON/( /DUM6(1600),OCTC,NAME(4,20),DUM7(800)
      COMMON/F /BAY(20,20),CEAC(20,20),ECT
      DIMENSI(N B(27),XZ(2),YZ(2),X(20),YC(20),YS(20)
      DATA B(:),B(6),B(7),B(13),B(18),B(19),B(25)/7*1HJ/
      DATA B(2),B(14),B(26)/3*1HF/
      DATA B(:),B(5),B(15),B(17),B(27)/5*1HM/
      DATA B(4),B(8),B(16),B(20)/4*1HA/
      DATA B(9),B(21)/2*1HS/
      DATA B(10),B(22)/2*1HO/
      DATA B(11),B(23)/2*1HN/
      DATA B(12),B(24)/2*1HD/
C
C REALIGN B VARIABLE I/A/W 1ST MONTH OF PROGRAM
      L1=1
      IF(HTN.EQ.7HJANUARY)GOTO 51
      IF(HTN.EQ.8HFEBRUARY)L1=2
      IF(HTN.EQ.5HMARCH)L1=3
      IF(HTN.EQ.5HAPRIL)L1=4
      IF(HTN.EQ.3HMAY)L1=5
      IF(HTN.EQ.4HJUNE)L1=6
      IF(HTN.EQ.4HJULY)L1=7
      IF(HTN.EQ.6HAUGUST)L1=8
      IF(HTN.EQ.9HSEPTEMBER)L1=9
      IF(HTN.EQ.7HOCTOBER)L1=10
      IF(HTN.EQ.8HNOVEMBER)L1=11
      IF(HTN.EQ.8HDECEMBER)L1=12
      L2=L1+15
      ID=0
      DO 64 IX=L1,L2
      ID=ID+1
64    B(ID)=B(IX)
C FIND LARGEST AND SMALLEST VALUES OF COST/SCHED DOLLAR VARIANCES.
51    BIG=SVD(NT,1)
      DO 1 IX=L,NOW
      IF(ABS(SVD(NT,IX)).GT.BIG)BIG=ABS(SVD(NT,IX))
      IF(ABS(CVD(NT,IX)).GT.BIG)BIG=ABS(CVD(NT,IX))
C LOOP TO NEXT MONTH
1     CONTINUE
C
C COMPUTE SIZE OF Y AXIS
      IF(BIG.LE.10)IG=30
      IF(BIG.GT.10..AND.BIG.LE.100.)GOTO 5
      IF(BIG.GT.100..AND.BIG.LE.1000.)GOTO 6
      IF(BIG.GT.1000..AND.BIG.LE.10000.)GOTO 7
      IF(BIG.GT.10000..AND.BIG.LE.100000.)GOTO 8
      IF(BIG.GT.100000..AND.BIG.LE.1000000.)GOTO 9
      IF(BIG.GT.1000000..AND.BIG.LE.10000000.)GOTO 17
      IF(IG.EQ.30)GOTO 11
C SET MULT. FACTORS
```

```
5      IG=IFIX(BIG/10.)*10+1
       IFAC=10
       GOTO 10
6      IG=IFIX(BIG/100.)*100+1
       IFAC=100
       GOTO 10
7      IG=IFIX(BIG/1000.)*1000+1
       IFAC=1000
       GOTO 10
8      IG=IFIX(BIG/10000.)*10000+1
       IFAC=10000
       GOTO 10
9      IG=IFIX(BIG/100000.)*100000+1
       IFAC=100000
       GOTO 10
17     IG=IFIX(BIG/1000000.)*1000000+1
       IFAC=1000000
10     IF(IG.LE.3*IFAC)IG=3*IFAC
       IF(IG.GT.3*IFAC.AND.IG.LE.6*IFAC)IG=6*IFAC
       IF(IG.GT.6*IFAC.AND.IG.LE.9*IFAC)IG=9*IFAC
       IF(BIG.GT.FLOAT(9*IFAC))IG=12*IFAC
C SET Y AXIS DIMENSIONS
11     D=FLOAT(IG)
       YSTART=-D
       DY=D/3.
C SET UP ZERO LINE
       XZ(1)=YZ(1)=YZ(2)=IC=0.
       XZ(2)=16.
       DO 14 IX=1,NOW
       IC=IC+1
       YC(IC)=CVD(NT,IX)
       YS(IC)=SVD(NT,IX)
       X(IC)=FLOAT(IC)
14     CONTINUE
       XN=FLOAT(NOW+1)/2.
       SY=SVD(NT,NOW)/DY+3.
       IS=IFIX(SVD(NT,NOW))
       CY=CVD(NT,NOW)/DY+3.
       IY=IFIX(CVD(NT,NOW))
       XY=FLOAT(NOW+3)/2.
       X1=XY+.5
       X2=XN-.1
C GRAPH ROUTINES
       CALL PLOT(2.,1.5,-43)
       CALL SCALE(XZ,2,1,8.,0.,2.,1)
       CALL SCALE(YZ,2,1,6.,YSTART,DY,1)
       CALL SCALE(X,IC,1,8.,0.,2.,1)
       CALL SCALE(YC,IC,1,6.,YSTART,DY,1)
       CALL SCALE(YS,IC,1,6.,YSTART,DY,1)
       CALL LINE(XZ,YZ,2,1,20,.07,0)
       CALL AXIS(0.,0.,7HDOLLARS,7,6.,90.,YSTART,DY)
       DO 13 IX=1,16
       SX=FLOAT(IX)/2.
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```
      DX=SX-.4
      CALL SYMBOL(DX,0.,4H----,4,.07,0.)
13    CALL SYMBOL(SX,0.,B(IX),1,.07,0.)
      CALL SYMBOL(X1,SY,1H%,1,.07,0.)
      CALL SYMBOL(X1,CY,1H%,1,.07,0.)
      CALL SYMBOL(X2,SY,1H$,1,.07,0.)
      CALL SYMBOL(X2,CY,1H$,1,.07,0.)
      CALL SYMBOL(-1.25,4.,9HFAVORABLE,9,.07,90.)
      CALL LINE(X,YS,IC,1,62,.07,1)
      CALL SYMBOL(-1.25,.2,11HUNFAVORABLE,11,.07,90.)
      OCTC1=OCTC/1000.
      GTB1=(GTB+FLOAT(MRC))/1000.
      BAY1=(BAY(NT,NOW)+GA1-GA+FLOAT(MRC))/1000.
      TCE1=(TCE(NT,NOW)+GA1-GA+FLOAT(MRC))/1000.
      CALL SYMBOL(.25,6.7,23HORIG CONTR TGT COST - $,23,.07,0.)
      CALL NUMBER(2.5,6.7,OCTC1,3,.07,0.)
      CALL SYMBOL(3.6,6.7,8H(THOUS.),8,.07,0.)
      CALL SYMBOL(.25,6.6,23HCURR CONTR TGT COST - $,23,.07,0.)
      CALL NUMBER(2.5,6.6,GTB1,3,.07,0.)
      CALL SYMBOL(3.6,6.6,8H(THOUS.),8,.07,0.)
      CALL SYMBOL(.25,6.4,23HGOVT ESTIM AT COMPL - $,23,.07,0.)
      CALL NUMBER(2.5,6.4,BAY1,3,.07,0.)
      CALL SYMBOL(3.6,6.4,8H(THOUS.),8,.07,0.)
      CALL SYMBOL(.25,6.3,23HCONT ESTIM AT COMPL - $,23,.07,0.)
      CALL NUMBER(2.5,6.3,TCE1,3,.07,0.)
      CALL SYMBOL(3.6,6.3,8H(THOUS.),8,.07,0.)
      CALL LINE(X,YC,IC,1,23,.07,1)
      CALL SYMBOL(.7,7.2,21HVARIANCE ANALYSIS FOR,21,.07,0.)
      CALL SYMBOL(3.0,7.2,NAME(1,NT+1),10,.07,0.)
      CALL SYMBOL(4.0,7.2,NAME(2,NT+1),10,.07,0.)
      CALL SYMBOL(5.0,7.2,NAME(3,NT+1),10,.07,0.)
      CALL SYMBOL(6.0,7.2,NAME(4,NT+1),10,.07,0.)
      CALL SYMBOL(7.0,7.2,NAME(5,NT+1),10,.07,0.)
      CALL SYMBOL(8.,6.,1H+,1,.07,0.)
      CALL SYMBOL(6.,6.5,18HC  $ COST VARIANCE,18,.07,0.)
      CALL SYMBOL(6.,6.4,22HS  $ SCHEDULE VARIANCE,22,.07,0.)
      CALL NUMBER(XN,SY,IS,0,.07,0.)
      CALL NUMBER(XN,CY,IY,0,.07,0.)
      SP=SVP(NT,NOW)*100.
      CP=CVP(NT,NOW)*100.
      CALL NUMBER(XY,SY,SP,2,.07,0.)
      CALL NUMBER(XY,CY,CP,2,.07,0.)
      IF(L1.GE.1.AND.L1.LE.11)XD=.5
      IF(L1.EQ.1)XD1=XD+6.
      IF(L1.EQ.2)XD1=XD+5.5
      IF(L1.EQ.3)XD1=XD+5.
      IF(L1.EQ.4)XD1=XD+4.5
      IF(L1.EQ.5)XD1=XD+4.
      IF(L1.EQ.6)XD1=XD+3.5
      IF(L1.EQ.7)XD1=XD+3.
      IF(L1.EQ.8)XD1=XD+2.5
      IF(L1.EQ.9)XD1=XD+2.
      IF(L1.EQ.10)XD1=XD+1.5
```

```
      IF(L1.EQ.11)XD1=XD+1.
      IF(L1.EQ.11)XD2=XD+7.
      IF(L1.NE.12)GOTC 15
      XD=0.
      XD1=XD+1.
      XD2=XD+7.
15    YD=-0.5
      CALL NUMBER(XD,'D,IYR,0,.07,0.)
      CALL NUMBER(XD1,YD,IYR1,0,.07,0.)
      IF(L1.LT.11)GOT 16
      CALL NUMBER(XD2,YD,IYR2,0,.07,0.)
16    CALL PLOT(8.,0.,3)
      CALL PLOT(8.,6.,2)
      CALL PLOT(0.,6.,2)
      CALL SYMBOL(2.,-1.5,26HSCHEDULE VARIANCE IN WEEKS,26,.07,0.)
      CALL NUMBER(5.,-1.5,SVW,1,.07,0.)
      CALL PLOT(0.,0.,-3)
      RETURN
      END
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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

14 PMSA-2-5

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

6 A COMPUTER PROGRAM FOR TRACKING COST/SCHEDULE CONTROL SYSTEM CRITERIA.

5. ~~TYPE OF REPORT & PERIOD~~ COVERED

9 FINAL rept.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

10 LOUIS M. SMITH

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS

~~DARCOM~~ OFFICE OF THE PROJECT MANAGER FOR SELECTED AMMUNITION, DOVER, NJ.

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS

12. ~~REPORT~~ DATE

11 JUNE 1977

13. ~~NUMBER~~ OF PAGES

93 12 98p.

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)

UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release. Distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Cost performance analysis, CS^2, computer model

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Report describes a computer program that provides a means for tracking contractor's performance where Cost/Schedule Control Systems Criteria are utilized. The program was specifically designed for the CDC 6500/6600 computer at USA Armament Research and Development Command, Dover, NJ. Input data are those normally found in a contractor's Cost Performance Report. Program output is a series of Cost and Schedule Performance Index graphs, a summary variance graph, and a set of tables.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

389515